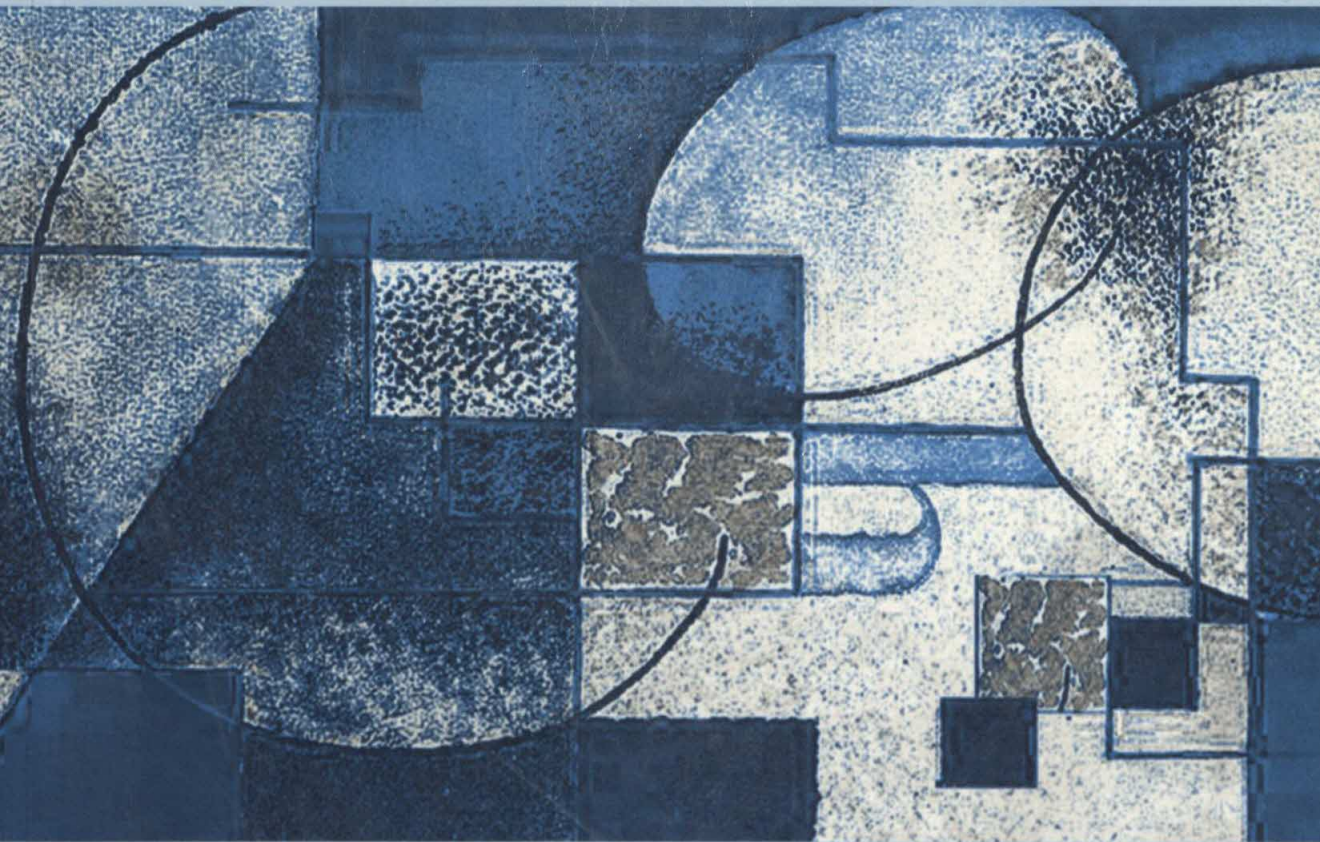


# ICT Strategies for Schools

A Guide for School Administrators



LAXMAN MOHANTY  
NEHARIKA VOHRA





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Laxman Mohanty  
Neharika Vohra



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**We would like to dedicate this book to the thousands of people  
who have worked in the area of ICT in education**

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## Foreword

The last few decades have witnessed an unprecedented flow of information across the globe consequent to the emergence of various technologies. The information and communication technology has played a significant role in this dynamics which has not only made access across the globe easier, but has facilitated integration of thought processes, synergy in working methods and places, participative and democratic functional approaches, team learning and in enhancing organizational transparency. Increasing awareness to and application of e-governance has opened newer vistas of management systems and facilitation strategies.

The emergence of knowledge society and need for enhanced competency building among knowledge workers as a continuous process has necessitated not only the introduction of ICT as a learning strategy in schools, but as an empowerment tool to the teachers and Principals. It is in this context that one feels the need for appropriate guidance to the Principals of schools so that they not only acquire the basic current knowledge about the advancements in this field, but become active users of the technology in all domains of the school environment.

Laxman and Neharika have done an excellent work in putting together all that is required for the Heads of institutions to become empowered learners, managers and leaders. They have taken care of a spectrum of inputs associated with the field of ICT and have expressed it in a lucid manner. This book will not only motivate the Principals to understand the various dimensions of technology, but I do hope they will be well motivated for effective use of ICT in their respective schools.

I compliment their efforts and I am sure the book will be very useful for the empowerment of the Principals.

**G. Balasubramanian**





## What Is ICT and What Are its Imperatives?

### Acknowledgements

A work of this kind would not have been possible without the help of several people directly or indirectly at different stages. At the outset, we acknowledge the support of Prof. Rajeev Sharma, from IIM Ahmedabad, a friend and a colleague, for both his ideas and encouragement. In fact, he is indirectly responsible for the genesis of this book. Several principals who attended our programs have expressed their frustration with the implementation of technology at their schools and the lack of a single source for guidance. This made us believe that it was worth the effort to put together various aspects of implementation of technology in schools in one book. We are grateful for their support. We would like to especially thank Mrs Meera Balachandran (Principal, Ramjas School, R. K. Puram, New Delhi), Mr Rajesh Hasija (Principal, Apeejay School, NOIDA), Dr A. K. Pandey (Principal, Maheswari Public School, Jaipur), Mrs Amita Mishra (Head Mistress, Delhi Public School, East of Kailash, New Delhi) and Mr Raja Pathak (Promoter, Swastik School, Ahmedabad) for allowing us to study the IT aspects of their schools and present them in this book as case studies; Mrs Urmila Nair (Vice Principal, St. Andrews, Hyderabad), Mr Bhaskar Reddy (Promoter, V. S. K. Memorial High School, Hyderabad) and Ms Anuja Thakkar (Research Associate, IIM, Ahmedabad) for writing brief case studies presented in this book; CEON Solutions and Anand Niketan, Ahmedabad for sharing information about their IT efforts; and Mrs Maharuk Singh, Principal, Mother's International School, New Delhi and Mrs Bharati Sharma, Amity International School, New Delhi for being generous in sharing their IT related policies. We would also like to express gratitude to Mr Sandeep Mishra and Dr Chitta Baral for providing various inputs for this book. Mr Dilip Sahu of Wipro Technologies needs special mention for providing a suggested IT infrastructure for schools.

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## What Is ICT and What

education is no exception. Significant strides in the field of education especially in schools. The S (Computer Literacy and Awareness in Secondary Schools) marked as the genesis of this movement. However, for a long referred to IT education (teaching of LOGO, BASIC and so hope been extended to include ICT in education and school

## 1.1 Role of ICT in Schools

## Role of ICT in Schools

It is felt that the aim of ICT should be to engage students at three levels: technical, practical, and critical. Students should not only learn to use technology (technical aspect), but they should also be able to use it in other activities referred to as its practical aspects (for example, in research, publishing and prediction) as also at the critical level, where

<sup>1</sup> Definition contributed by anonymous reviewer of this book.





students must learn to evaluate the appropriateness of the message, audience, and method used (<http://www.techknowlogia.org>, April–June, 2002). The five As of information literacy are shown in Box 1.1.

Box 1.1  
5As of information literacy

Asking  
Accessing  
Analyzing  
Applying  
Assessing

ICT in education refers to the use of educational technology in teaching and learning processes. ICT is used as an enabler for teaching all subjects ranging from art to mathematics. There is evidence to show that learning is superior when Computer Aided Instructions (CAI) or Computer Aided Learning (CAL) is used compared to the conventional method (Biswas 1994). The use of technology can facilitate a move from didactic classroom teaching to participatory, decentralized, and interactive group learning. Creative use of ICT can also make it possible to unify knowledge rather than learning various subjects discretely.

It is argued that the effective use of ICT can help teachers meet the changing requirements of education in a more efficient way. ICT provides the tools to explore and collect information with greater ease, thus leaving enough time to analyse and integrate information. It makes memorizing redundant by making information available at the click of a button.

ICT in education can fundamentally change the focus and goals of education. Thus, it becomes essential for school principals to take strategic decision about the use and implementation of ICT in their schools to be able to meet the needs of the students and industry.

With the widespread use of technology, there is a shift in education goals towards:

- Exploration and problem solving rather than memorizing and learning the *status quo*;
- Processing of information rather than mere collection of information; and
- Search for patterns and connections rather than linear sequential reasoning.

Studies also indicate that new skills are required from the workforce. Since schools prepare children to enter the workforce (see Box 1.2 for outcomes of such study), as one of their goals, it is necessary that heads of schools get involved in understanding how new trends and developments in ICT could be used for meeting the future needs of the students and the society.

## Box 1.2

## New skills for the workforce

Good communication skills (reading, writing, speaking and listening)  
 Ability to learn independently  
 Teamwork skills  
 Social skills (ethics, positive attitude, responsibility)  
 Ability to adapt to changing circumstances  
 Thinking skills (problem solving, critical, logical and numerical skills)  
 Knowledge navigation (knowing where to go and how to process information)

*Source:* Conference Board of Canada. 1991. *Employability skill profile: The critical skills required of the Canadian workforce*. Ottawa: Conference Board of Canada.

ICT in school administration refers to the use of computers and related technology in various aspects of running and managing the school. It is believed that its use in schools could enhance productivity (Linderholm 2001) just as it has in the corporate world. It could especially enhance productivity for repetitive tasks and if used in administration, it could help managing school activities inexpensively, accurately, and easily.

What is required for schools is seamless integration of all three elements: IT education, ICT in education, and ICT in administration. The principals of schools should play a key role in the integration of ICT with school functioning. For this, they need to understand their role and upgrade their skills.

## 1.2 Role of Principals in Making Schools IT Savvy

### 1.2.1 Implications for Principals

As discussed in the previous section, principals in schools have an important responsibility in the form of guiding usage of ICT in schools. For this to be effective, he/she needs to:

- Understand the technology and its implications.
- Understand learning processes to be able to integrate use of ICT in education.
- Create a road map for the school to use ICT.
- Find appropriate personnel, train them, and let them carry forward various tasks.
- Upgrade his/her IT skills to be able to handle certain operational problems when the need arises.
- Keep abreast of the emerging trends in ICT and find out how schools can benefit from those changes.



- Make provisions in the school budget for ICT needs.
- Find ways of providing access to ICT for all stakeholders.
- Create excitement among teachers and students to experiment.
- Look into the recommendations made by experts on the use of ICT in schools and develop their own standards. (An example of such recommendations given in the Report to the President on the Use of Technology to Strengthen K-12 Education in the United States is included in Box 1.3)

### Box 1.3

#### Recommendations for the use of information technology

Sample recommendations given in the Report to the President on the Use of Technology to Strengthen K-12 Education in the United States:<sup>2</sup>

- Focus on learning with technology, not technology itself
- Emphasize content and pedagogy, not hardware
- Pay special attention to professional development
- Realistic budgeting is crucial
- Equitable and universal access is essential
- Initiate a major program of experimental research

## 1.2.2 How IT Savvy Should Principals Be?

Personal interactions and experience show that most school principals have shirked learning about IT and have not taken an active role in ICT implementation in the schools. They have assumed that IT is not their cup of tea and thus it is best to leave it to professionals. But being the leaders of their organization, principals have to acquire a basic understanding of this technology. They not only need to take an active role in designing and implementing ICT programs in their schools, but should also try to measure and understand the impact of such programs so that corrective measures can be taken at an appropriate time or future programs can be made more effective. Leadership for technology calls for principals to master various aspects of it (Reksten 2000) so that they can drive the information strategy for schools.

The minimum ICT knowledge that principals should have are:

- Use of word processor and presentation of graphics software.
- Comfort with e-mailing and Net surfing.
- Basic appreciation of various technologies used in schools.
- An understanding of where technology can make a difference.

<sup>2</sup> The Jossey-Bass Reader on Technology and Learning (pp. 3–19).



This book is designed to act as a guide for principals in their new and enlarged role. The various chapters give basic information on what a principal needs to know to be able to make decisions on various ICT related issues. Some case studies provide illustrations of how different schools have used ICT in different areas.

#### Box 1.4

##### Some facts/concepts school principals must know

**Free e-mail:** Yahoo, Indiatimes, Rediffmail, Hotmail, and Gmail, etc., offer free e-mail ID and a large space to store mails. With Gmail offering 1 GB space, all other free e-mail services started following it. Principals can take benefit of these facilities and be in touch with others electronically.

**Online Newspapers:** Now-a-days, most newspapers have online versions. Besides, news services like Wikinews carry information on every country contributed by locals and Google News pools in news from 4,500 sources. Websites like Rediff provide some interesting news and articles too.

**Search engines:** Today search engines are powerful tools for information. In Google, putting in a keyword gives lots of information on any topic. There are also meta search engines which can use several search engines to find more appropriate set of links.

**Desktop search:** Google (see <http://www.desktop.google.com/>) and Microsoft have come up with search engines which can be installed on the PC and help search any document, photo, audio, and video. This makes the task of finding the relevant file out of tons of them more easier.

**Spyware:** It is a kind of software which gets hosted in the user computer when other software, with which it comes is being installed. Once installed, it performs several activities which may be detrimental to the user. For example, it may get the personal information of the user including credit card number and send it to a third party for misuse. It can also trigger unsolicited pop-up ads and direct to advertisement sites.

**Caution with credit card on Net:** Now-a-days, one can buy train and air tickets and other things online easily. However, one should be cautious while giving credit card details. There can be a fraud site that can take the number and misuse it.

**Spams:** Spams are unsolicited e-mails. Some scrupulous people manage to get hold of other's mail ID or create fake ones and send mails that carry unwanted information, virus, and pictures. Most of the e-mail software now have spam protection facility, still several such mails get into the inbox. Therefore, one should not open an attachment which one is not sure of and delete that mail; it may contain virus.

**Hoaxes:** Sometimes one might have come across some scheme where a person from a rich family from Nigeria or some other African country is in distress and is interested to transfer millions of dollars to the other person's account. All they need is the account number and they are ready to share money with you. Many have responded and have paid some money towards transfer cost and then have received nothing. Similarly, there are many 'get to riches' e-mails and one should not get tempted by them.

**Chain mails:** These are mails where one is asked to forward it to some other people in return for something good or some dollars from Microsoft. Again, one should not waste time by taking this kind of mails seriously and responding to it.

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## Hardware and Network

The main questions that this chapter addresses are 'What are the hardware and networking setup that a school needs?' and 'How does a principal go about procuring them?' and other such questions related to hardware.

### 2.1 Hardware

Hardware by definition means, the physical aspects of a computer system: the CPU (Central Processing Unit) box, monitor, and the keyboard, etc. In fact, while buying a CPU box you may come across following components:

- CPU
- Motherboard
- RAM
- Hard drive
- SMPS (Switch Mode Power Supply)
- Sound Card
- Video card
- CD-R/RW
- DVD
- Modem
- NIC
- Other cards

The CPU is the heart of the system and it determines the processing capability of the computer. A computer with Pentium-IV processor is supposed to be more powerful in terms of processing in comparison to one with Pentium-I. The motherboard holds the processor and other associated chips like memory chips and controllers. The RAM indicates the available primary memory of the computer. While the computer is processing, RAM stores data, instructions, and intermediate results. Power supply (SMPS) provides stabilized and stepped down DC power to all electronic components of the computer while sound and video cards process sound and video inputs. The computer may have a DVD player or a CD drive



to read and write CD-ROMs. A modem helps to connect the computer to the telephone line so that the Internet can be accessed. NIC is the network card that connects the computer to a computer network.

### Box 2.1

#### The birth of microcomputer

In January 1975, the cover page of the American magazine 'Popular Electronics' showed a computer, called the Altair, which one could build at home. The article inside described a computer kit, which could be ordered from a company called MITS for just \$397. At that time, it was simply unthinkable to get a computer at such a low price. Four thousand people responded and sent \$397 each to MITS for a product no one had ever seen! The Altair that Ed Roberts, the owner of MITS, sent to each customer was nothing more than a box, a CPU (8080) with just 256 bytes of memory and a front panel with switches and lights. It had no keyboard and no monitor. The buyers needed skill and several hours of time to assemble the computer. In many cases, it simply did not work. But, the whole event gave birth to the microcomputer revolution.

In general, a school requires the following hardware as part of its ICT infrastructure:

- Computers (including desktop, laptop, and handheld computers)
- Digital cameras and digital video cameras
- Telephones, fax machines, mobile telephones, and tape recorders
- Programmable toys and 'control' technologies
- Videoconferencing technologies and closed-circuit television
- Data projectors and electronic whiteboards

Like cars, there are computers of various types and capacity. Schools need to buy adequate hardware to start an ICT program, and therefore, choosing the right hardware is an important issue. Some of the criteria and constraints that need to be kept in mind while making buying decisions are described in what follows.

## 2.1.1 Criteria and Constraints for Selection of Hardware

- *Providing the latest vs. larger number of computers:* Schools must understand that they need a larger number of computers rather than the latest and the fastest ones. A machine with Pentium-I is good enough to run all standard software and multimedia applications. However, formulations have their advantages and disadvantages as presented in Table 2.1. A principal may want to weigh both the pros and cons before making a decision about what hardware to buy. Thus, when buying decisions are made, it may be best to opt for what is most easily available in the market for a reasonable price and then use the same for as long as possible rather than upgrading as soon as a new

**Box 2.2**  
**Latest useful hardware for school**

**Pen drive**

To carry around large amount of data, a new storage device called pen or thumb drive is used. It comes with a capacity of 64, 128, 256 Mb or more (upto 10 GB) and looks more like a thumb. Flash memory is used in a pen drive. It is easy to carry and can be connected to a USB port to write or read data. Windows XP recognizes a pen drive automatically while one needs to install a driver for systems using Windows 2000 or Windows 98. Now-a-days floppy disks are almost obsolete and writing a CD requires a CD writer and unlike a pen drive, CD is not handy. Pen drive is therefore, emerging as the most popular storage device for carrying data.

**K-Yan**

K-Yan developed by IL&FS Education & Technology Services (IL&FS ETS) in association with Indian Institute of Technology, Bombay, combines computer, LCD panel, TV and audio system into a single compact system. A teacher can present concepts from a CD, information from the Internet, programs from cable TV or their own electronic presentations using the same machine. The system has a wireless keyboard with remote-cum-mouse and it also comes with a specially designed multimedia content developed by IL&FS ETS.

**Smart Cards**

Smart cards can be used by schools to keep updated and detailed information about students. It can even be used as a library card and for other transactions like buying items in the school tuck shop. In case of an emergency, the health history of the student (which can be stored in the smart card) can also be retrieved from it. Teachers can also use them for keeping a track of students' attendance.

model is launched. Schools must make their decisions about hardware from the point of view of more access to students. For example, if three Pentium-III systems can be bought for the cost<sup>1</sup> of two Pentium-IV systems, a principal must choose the former option as it will allow more students to have access.

**Table 2.1**  
**Advantages and disadvantages of the latest and not so latest hardware**

|                 | Advantages                                                                                                 | Disadvantages                                                                                                 |
|-----------------|------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Latest hardware | <p>Easily available</p> <p>Can run the latest software</p> <p>Maintenance is easy</p>                      | <p>Expensive</p> <p>Older software may not need its processing power</p> <p>Unstable technology at times</p>  |
| Older hardware  | <p>Less expensive</p> <p>Technology is proven</p> <p>Support for use available from the existing users</p> | <p>Not so readily available</p> <p>Maintenance could be expensive</p> <p>Spare parts may not be available</p> |

<sup>1</sup> More details about evaluating and buying hardware and software are included in chapter 6.



- *Costs in the long run vs. short run:* Besides computers, the schools also need to buy sufficient number of peripherals like printers and scanners, etc. In case of printers, one has the option of buying either an inkjet or a laser printer. While the former costs less at the time of buying, its per page cost is quite high. It prints slowly and cannot handle a large volume of printing. Thus, schools must buy one or two high-speed laser printers that can be connected to the network. Certain people can be given individual printers depending on their need for printing frequent or confidential documents. For example, the principal may have one, as his/her requirement for printing may be small, but the print quality of official and confidential documents has to be good. Similarly, the examination section can also be given an individual laser printer where print quantity may be high and there is a need for maintaining confidentiality.

### Box 2.3

#### Guiding principles for selection of hardware

- Undertake a thorough need analysis
- Buy what you need
- Collect data about both hardware/software (also learn the technology better)
- Talk to many vendors to get a comparison
- Talk to experts and other users to get their views
- Don't judge a computer by its brand name
- Be skeptical of hard sells by vendors
- Weigh costs in the long run versus short run
- Assess whether a particular hardware or software increases access

## 2.2 Networking

Networking is a mechanism by which stand-alone computers can be connected through cables or wireless links so that these computers can communicate with each other and can share common resources like software, data, and peripheral devices. Networking reduces computing and storage costs and makes communication faster. Internet in reality is also a large network spread all over the world. Local area network (LAN) refers to a network which is limited to all the computers in a building or a number of buildings in a campus. Each user on a LAN uses his/her login name and password to enter into his/her own hard disk space from any workstation, works on an application, and then stores data and documents generated in his/her allotted disk space.

In most schools, only computers in the lab are networked, while those in the staff room or principal's office are often not connected to the school LAN. Some schools also set up a separate LAN for each of their labs. But to benefit from networking, the schools must opt



### Box 2.4 Some PC concepts

From different sources, you must have come across many PC related concepts or terminologies, which are still not well understood by you. In fact, with rapid development in the field of computers, it is really difficult to keep abreast of all the new terminologies that are being coined almost every day. So here, the most common concepts are explained.

**Multi-tasking:** It is the ability of a CPU to perform several tasks at a time, such as printing a document or doing a mathematical calculation by quickly switching its attention among different programs. Earlier operating system like MS-DOS (Microsoft Disk Operating System) did not have any multitasking capacity, but Windows supports many programs to run simultaneously on the same computer. You must have seen how easy it is to run two or three applications on the same screen and then copy some information from one and paste the same on the other.

**Expansion slots:** You will be surprised when you open your CPU box to find a lot of empty space. On closer inspection, you can identify the motherboard. You will find small PCBs mounted on it and there may be some empty slots which are called expansion slots, and are used for optional boards like sound blaster card, network card, and serial port card, etc. It is so called, because you can expand the power and facilities of a computer by adding different cards in these slots.

**Ports:** Have you noticed how a printer is connected to a computer? It is normally plugged into an inlet which is called a 'port.' These are the processor's general means of communicating with any computer circuitry other than memory. Data can be read from or written to any port. A port is identified by a number. Parallel port enables the CPU to send one byte in one go (all the bits in parallel wires). This is a very fast way of sending data but it becomes very expensive and difficult to control if the distance is more than a few metres. In contrast, a serial port sends bits of information one after the other (serially) using one wire. Its advantage is enormous when one sends data over a long distance. Serial ports are very often used for communication. The parallel ports are named as LPT1 and LPT2 (short for Line Printer) and serial ports are named as COM1 and COM2, etc. (for COMMunication). The port to which a printer is normally connected is a parallel port while a mouse is connected to a serial port.

**The BUS:** In the PC family of computers, we have several additional cards (PCBs) apart from the main motherboard, which need to interact with each other for exchanging data and instructions. As per the architecture of PCs, there is a common path through which data or instructions are passed from one component to the other. This is known as a 'bus.' We can think of it as a highway which enables sending/receiving of data/ instruction inside the computer. A slower bus can slow down a very fast processor. These buses typically have 8, 16, 32 or 64 wires; a bus with 32 wires is called a 32-bit bus because it can transmit 32 bits of information at once, twice as many as a 16-bit bus.

Depending upon the kind of use, a bus can be put into either of the three categories—the data bus, the address bus, and the control bus. The data bus transmits information, while the address bus selects memory locations and the control bus regulates both.

There are also different bus architectures, which determine the performance of a personal computer. The earliest PC had the bus which was called PC BUS. It was a slow circuit. With the introduction of PC-AT, PC BUS

(Box 2.4 continued)

(Box 2.4 continued)

was replaced by a more efficient one known as ISA (Industry Standard Architecture). With the advent of 80386/80486 microprocessor, this too was found to be inadequate. Soon two more new architectures emerged to replace it—MCA and EISA BUS. MCA or Micro Channel Architecture was developed by IBM, while EISA or Extended ISA was designed by the competitors of IBM. EISA's successor came to be known as LOCAL BUS. The next one was the PCI (Peripheral Control Interface) BUS. Thus, there have been continuous efforts to develop efficient and faster bus which can sustain the increasing demands of the processing power of the PCs.

**Buffers:** A buffer is a computer memory which is used to store data for some time before it is sent out to the output devices or taken into the CPU for processing. It is basically used between two devices to compensate for the difference in the rate of flow of data, or in the time of occurrence of events. For example, a keyboard has a buffer which stores the keystrokes till they are processed by the computer. Sometimes you must have observed that when you are typing fast during some program execution, the keyboard starts giving beeps after accepting few keystrokes from you. This is because its buffer gets filled up. Since the computer does not take in the keystrokes stored in the keyboard buffer as it is busy, the beeps warn you that they are getting lost as there is no more space to store them.

**Add-on memory:** Apart from the standard memory given in the motherboard, RAM (Random Access Memory) capacity of a computer can be enhanced by adding memory chips in the increments of 32 to 256 MB to achieve the maximum main memory capacity of the CPU.

**Cache memory:** It is an additional block of very fast memory (SRAM) which is used as a working storage for the processor to read and write data directly without having to wait for the slower disks to complete the task. Normally the processor needs to wait for some time before it can complete any read or write operation on the main disk storage. By using cache memory, which is quite expensive, this waiting can be reduced and processing can be made faster. Thus the size of cache memory in a PC is in the range of 128 KB to 256 KB.

**Plug and Play:** Earlier in DOS, adding a new device to the system was a difficult task. Apart from physically connecting the device, the user had to copy a particular device driver program (a program which facilitates communication between CPU and the new device) to the hard disk and add the path and parameters in the CONFIG.SYS file. But operating systems like Windows has made life easier. After you physically connect the device, it senses the same, finds appropriate device driver and allocates relevant access parameters to it so that the device becomes available for use.

**Static:** Static is a high voltage charge caused by friction on highly insulating materials such as nylon. People walking on a nylon carpet carry thousands of volts just waiting to run to earth through any convenient conductor. The static charge does not harm human beings, though in extreme cases they may actually feel the shock. It is a very low current discharge, but can destroy a sensitive electronic component.

for a campus wide network rather than having separate, small LANs or leaving out several of the computers unconnected to the school LAN. Peripherals like high speed printers and scanners can then be connected to the campus LAN so that it can be used by everyone. Thus, on an overall and long-term basis, this arrangement would be cheaper.



Campus wide network also allows separate login, password, and an independent space for each teacher. Without this facility, teachers may be forced to use floppy disks to save their work and copy it back to the hard disk when they work on another computer later. Floppy disks are unreliable and get corrupted easily, which means there is always the danger of losing data. The other option of keeping data in the local hard disk of PCs poses problems as it can be read or deleted by somebody else.

#### Box 2.5

##### Questions to ask before opting for networking

**Quality of information to the user:** When a student or a teacher sits in front of a computer what kind of resources are available to him/ her? Does the network help the user in research and problem solving?

**Communication and collaboration:** Does the network support in exchanging ideas, resources, and inventions?

**Access:** Does the network provide all time and easy access to resources so that users have rich information and powerful tools to use?

**Evidence of use:** The administration should design a system so that it can assess the use of network and also take corrective actions in case use falls below expectation.

Source: McKenzie, J. 1997. 'Networking schools: For what purpose?' *Now On—The Educational Technology Journal*, 6(9). <http://www.fno.org/june97/purpose.html>

## 2.2.1 Thin Client

In order to reduce hardware cost, the use of a thin client or thin computers have become popular. It is a computer without hard disk, is rugged, and depends totally on the server for any application. The data and programs are all stored in the main server. A thin client can be available at almost half the cost of a desktop computer. Also, by connecting an uninterrupted power supply (UPS) to the main server, the work of all the users can be saved in case of power failures. Schools which are in the process of opting for networking can explore the use of thin computers.

## 2.2.2 Wireless LANs

Today the world is moving towards wireless in order to reduce cable laying costs and providing greater flexibility to users. In this, the computers are connected using radio modems and can be moved anywhere within a given area. Pathway School in Gurgaon claims to be the first school in India to opt for wireless LAN which can be set up by deploying the WiFi or WLL technology.



### Box 2.6

#### What is WLL?

WLL (wireless in local loop) is a system that connects users to the public switched telephone network (PSTN) using radio signals instead of copper for all or part of the connection between the user and the switch. This includes cordless access systems, proprietary fixed radio access, and fixed cellular systems. Thus, a service provider has to lay down copper till the last mile and only there, the wireless is used. In case of WLL, the transmitter power required is less and its number per particular area is fewer. This brings down the cost. The Government of India has issued license for WLL without charging any fee (unlike the case of GSM service providers) which has further reduced the cost. IIT Madras has developed a WLL technology.

### Box 2.7

#### What is WiFi ?

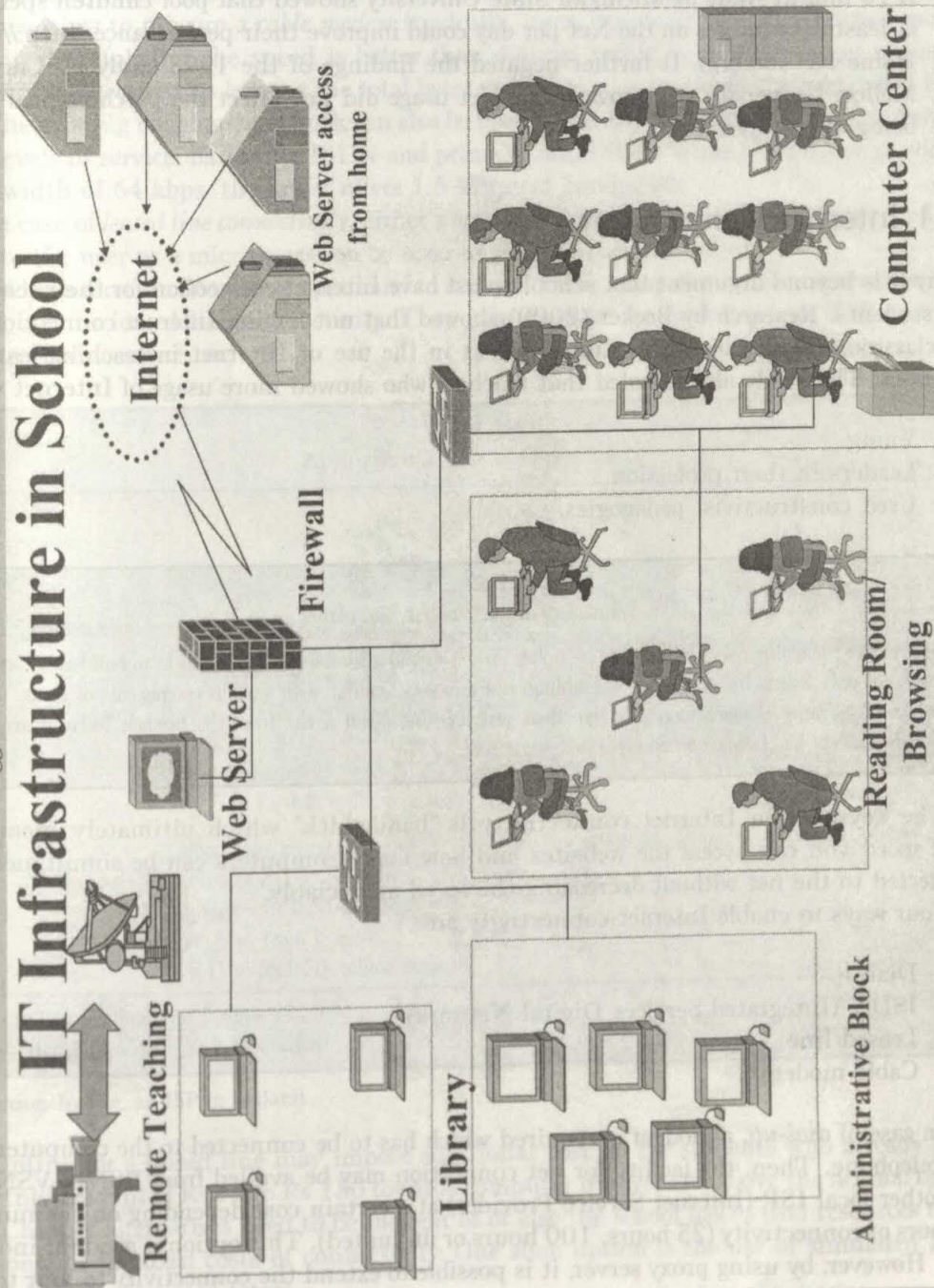
WiFi stands for Wireless Fidelity, a technology that allows a user to connect to Internet from anywhere and without requiring a cable connection. There is a base station and within a certain radius, one can connect the computer to it and access the net. The speed is much higher than any available modem. WiFi networks use radio technologies called IEEE 802.11b or 802.11a to provide secure, reliable, fast wireless connectivity. It can be used to connect computers to each other, to the Internet, and to wired networks. They operate in the unlicensed 2.4 and 5 GHz radio bands, with 11 Mbps (802.11b) or 54 Mbps (802.11a) data rate. One can use it at home to connect computers too. WiFi networks are also found in busy public places like coffee shops, hotels, airport lounges, and other locations where large crowds gather. Organizations like Wipro and HLL have opted for this technology which can be useful for schools when it becomes little inexpensive in future.

## 2.3 Internet

Internet is sometimes referred to as the mother of all networks. With thousands of computers all over the world connected to each other through satellite, cables, and radio waves, the information stored in those computers can be shared. The world has become a small village owing to the use of Internet. Virtually anybody with an Internet connection can contact another person sitting anywhere in the world through e-mail, online chat, and video conferencing. It is also a vast repository of information on a wide range of topics which can be retrieved at the mere click of a mouse and has influenced all spheres of life ranging from business, health, and education. Schools have found Internet as an effective tool in their teaching and learning processes. The following studies have shown its benefits for schools:

- A study by Rajsekhar and Bhattacharjee (2000) showed that students found the interactive content of Internet much more interesting than the content delivered through the chalk-and-talk method. Online helpers made self-study easier.

# IT Infrastructure in School





- A 16 month study by Michigan State University showed that poor children spending at least 30 minutes on the Net per day could improve their performance (<http://www.HomeNetToo.org>). It further negated the findings of the 1998 study by Carnegie Mellon University and proved that Net usage did not affect the psychological well-being of children.

### 2.3.1 Internet Connectivity

Today it is beyond argument that schools must have Internet connection for their teachers and students. Research by Becker (2000) showed that not having Internet connections in the classroom would become an impediment in the use of Internet in teaching/learning processes. The study also revealed that teachers who showed more usage of Internet were:

- Young
- Leaders in their profession
- Used constructivist pedagogies.

#### Box 2.9

##### What is constructivist learning?

Constructivist learning refers to 'learning by doing.' When a child assembles different blocks to build a motorcar, he/she not only learns the process of assembling, but also gets familiar with various components of a car. This process of learning is much more effective than just listening about a car from the teacher. Today, learning through projects has become an effective pedagogic tool.

The keyword in Internet connectivity is 'bandwidth' which ultimately means at what speed you can access the websites and how many computers can be simultaneously connected to the net without decreasing the speed appreciably.

Four ways to enable Internet connectivity are:

- Dial-up
- ISDN (Integrated Services Digital Network)
- Leased line
- Cable modem

In case of *dial-up*, a modem is required which has to be connected to the computer and the telephone. Then, the facility for net connection may be availed from BSNL, VSNL or any other local ISP (Internet Service Provider) at a certain cost depending on the number of hours of connectivity (25 hours, 100 hours or unlimited). This option is good for individuals. However, by using proxy server, it is possible to extend the connectivity to four to five computers using the dial-up modem.



Currently, some ISPs also provide Net connectivity through existing cable networks. The user has to procure a *cable modem* (typically, more expensive than the normal modem used in dial-up). But the speed is better than dial-up and it is possible to get unlimited hours of connectivity as long as the total bytes uploaded remain within the prescribed limit.

The existing telephone network can also be used to get *ISDN connectivity*, which provides two levels of service: basic rate ISDN and primary rate ISDN. While the former provides a bandwidth of 64 kbps, the latter offers 1.5 Mbps of bandwidth.

In case of *leased line connectivity*, either a separate optical fiber can be laid from the ISP's hub to the user or a microwave can be used to provide the connectivity.

To have a reasonable access speed and to connect many computers to the network, schools must opt for leased line connectivity. They can also opt for cable modem if they already have a cable connection.

| Box 2.10<br>Approximate cost for leased line                                                            |                                                                                                                                                                                                       |                 |                                 |
|---------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------------------|
| Number of systems connected to the Net                                                                  | Initial requirement and individual cost                                                                                                                                                               | First year cost | Recurring cost from second year |
| 30                                                                                                      | 64 Kbps lines rental from DOT—<br>Rs 25,000-30,000 annually<br><u>Hardware (four modems and one router)</u><br>—Rs 0.13 million<br>64 Kbps bandwidth from ISP—<br>Rs 0.15 to Rs 0.18 million annually | Rs 0.33 million | Rs 0.21 million                 |
| 150                                                                                                     | 2 Mbps lines rental from DOT—<br>Rs 60,000-75,000 annually<br><u>Hardware</u> —Rs 0.30 million<br><u>Bandwidth from ISP</u> —<br>Rs 0.45 to Rs 0.50 million annually                                  | Rs 0.88 million | Rs 0.58 million                 |
| Radio link hardware for 2 Mbps—Rs 0.30 to Rs 0.40 million<br><u>VSAT</u> (only 64 Kbps)—Rs 0.35 million |                                                                                                                                                                                                       |                 |                                 |

Source: IceNet, an ISP in Gujarat.

Opting for a leased line may impose additional cost on the students who already pay a monthly amount of Rs 40 to Rs 150 towards computer fee over and above the normal tuition fee. Cheaper alternatives need to be thought of or else the school has to find resources to pay for some of the fixed costs of connectivity. One such option is the use of simulated Internet (which is discussed later).

### 2.3.2 Broadband

Broadband is the common term for a high bandwidth Internet connection—one that can transmit or download information up to 40 times as fast as a standard telephone and modem. One can do everything online, quickly and more easily with broadband. It offers the following advantages (Becta 2001):

- A connection which is always on.
- The cost is fixed.
- Potentially much faster download.
- Enables the practical use of video and audio media.
- Cheaper than ISDN for comparable speeds.
- Can support online and video rich learning and teaching processes.

The three sources to get broadband connectivity are:

- Fixed cable leased line
- Wireless
- Satellite

In the fixed cable leased line, two technologies—Digital Subscriber Line (DSL) and Asymmetric DSL (ADSL) are quite popular. In wireless, WiFi is becoming popular while another technology, WiMax is emerging as a hot contender.

Broadband enables effective transmission of real life video data thus allowing schools to make use of video conferencing facilities. Now a days Bharat Sanchar Nigam Limited, Satyam Infoway, and Reliance Telecom etc., are providing broadband facility even to individual users at a nominal cost.

### 2.3.3 Simulated Internet

If Internet connectivity is difficult because of cost or any other technical reasons, the entire Website can be copied to a CD and the same can be given to students for exploration. 'Web-copier,' a software, helps copy an entire website. These 'Internet' CDs also restrict students from accessing unwanted information and concentrate on what is available. Thus, combining simulated Internet with limited Net connectivity can provide the same kind of connectivity as leased line.



## Box 2.11

## Sample cost chart for setting up IT facilities in schools

**Phase-I: Basic infrastructure**

| <i>Description</i>                                                                                                                                                                                                        | <i>Expense</i>  | <i>Remarks</i>                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Capital Expenses</b>                                                                                                                                                                                                   |                 |                                                                                                                                                                       |
| Hardware<br>20 Pentium grade computers, one Network server,<br>Networking cards, Components and cabling,<br>Multimedia kit, Fax-modem, one Laser printer.                                                                 | Rs 0.60 million | With one year warranty and maintenance.                                                                                                                               |
| Software<br>Networking software, Operating system, Internet and<br>Web related software, Popular application software.                                                                                                    | Rs 0.06 million | Public-domain software to be used wherever possible.                                                                                                                  |
| Professional charges for external technical<br>assistance in implementation, etc.                                                                                                                                         | Rs 0.10 million | Since many schools do not have or need to have separate technically-skilled manpower to implement the plan, assistance of professional organizations may be required. |
| <b>Sub-total</b>                                                                                                                                                                                                          | Rs 0.76 million | Capital investment for four years equivalent to recurring expense of Rs 0.12 million per year.                                                                        |
| <b>Recurring Expenses (Per year)</b>                                                                                                                                                                                      |                 |                                                                                                                                                                       |
| Courseware Procurement                                                                                                                                                                                                    | Rs 0.03 million | Will be accessed via CD-ROM/Internet/WWW.                                                                                                                             |
| Internet connectivity<br>TCP-IP account with VSNL (at least two)                                                                                                                                                          | Rs 0.01 million | Total usage of 1,000 hours.                                                                                                                                           |
| Human Resources                                                                                                                                                                                                           | Rs 0.19 million | If two computer teachers are recruited.                                                                                                                               |
| Miscellaneous Expenses<br>Books, Consumables, etc.                                                                                                                                                                        | Rs 0.02 million |                                                                                                                                                                       |
| <b>Sub-total</b>                                                                                                                                                                                                          | Rs 0.25 million | Recurring expenses per year.                                                                                                                                          |
| <b>Phase II: Additional infrastructure</b>                                                                                                                                                                                |                 |                                                                                                                                                                       |
| <b>Capital Expenses</b>                                                                                                                                                                                                   |                 |                                                                                                                                                                       |
| Hardware<br>30 Pentium grade computers, two-three Network<br>server, one Work-station grade computer to function<br>as a web-server, Networking cards, Components and<br>cabling, Multimedia kit, one-two Laser printers. | Rs 1.10 million | With one year warranty and maintenance.                                                                                                                               |

(Box 2.11 continued)



(Box 2.11 continued)

| <i>Description</i>                                                                               | <i>Expense</i>  | <i>Remarks</i>                                                                                                                                                   |
|--------------------------------------------------------------------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Routers/leased-line modems for leased-line connections.                                          |                 | Router/leased-line modems are required only on the campus network which 'receives' the leased line.                                                              |
| Color scanner                                                                                    |                 |                                                                                                                                                                  |
| Software                                                                                         |                 |                                                                                                                                                                  |
| Internet and Web-related server software, Image-editing and Web-authoring software.              | Rs 0.22 million | Public-domain software to be used wherever possible; most hardware vendors offer software as part of their web-server package.                                   |
| Professional charges for external technical assistance in implementation, etc.                   | Rs 0.10 million | Since many schools do not have or need to have separate technically-skilled manpower to implement the plan.                                                      |
| <b>Sub-total</b>                                                                                 | Rs 1.42 million | Capital investment for four years equivalent to recurring expense of Rs 0.36 million per year.                                                                   |
| <b><i>Recurring Expenses (per year)</i></b>                                                      |                 |                                                                                                                                                                  |
| Internet connectivity                                                                            |                 |                                                                                                                                                                  |
| 64 Kbps leased line Internet account with VSNL, MTNL/BSNL. Leased-line from campus to VSNL host. | Rs 0.36 million | VSNL charges: 0.23 million.<br>MTNL/BSNL charges: Rs 0.14 million.                                                                                               |
| Human Resources                                                                                  | Rs 0.29 million | If three computer teachers are recruited.                                                                                                                        |
| Miscellaneous expenses                                                                           |                 |                                                                                                                                                                  |
| Books, Consumables, etc.                                                                         | Rs 0.03 million |                                                                                                                                                                  |
| <b>Sub-total</b>                                                                                 | Rs 0.68 million | Recurring expenses per year. In case two or more schools located in close proximity decide to share the leased-line, recurring expenses will be equally divided. |

*Note:* This Table is based on the one provided by Navin Singh, Shrinivas Iyengar and Chirag Shinde in the paper 'Information Technology and College Education—Prospects and Proposals' published in *New Frontier in Education*, Vol. XXVII, 1997.

## 2.4 Annual Maintenance Contract

Computers used by students in schools require good maintenance support. Otherwise, classes may get disrupted. For this, the schools have two options: (1) opt for Annual Maintenance Contract (AMC) with the supplier or with a third party; (2) employ maintenance staff. The second option is feasible if the school has a large number of computers and paying salary to one/two maintenance engineers and storage of some common spare parts can be justified. Otherwise the schools have to go for AMC with an outside party. Often the response of the outside party for the breakdown and other requirements may not be satisfactory. To alleviate that, the school can set up a penalty clause in the contract they sign with the party. Depending on the workload, the vendor can be asked to depute a hardware engineer to be present in the school all the time. The schools can also insist on regular preventive maintenance which can take care of minor problems with machines.

Besides these, all users may be taught some basic maintenance skills. Most of the time, the plug point may be loose or the cable might be disconnected. It is better to do a basic check rather than call a hardware engineer and wait for him/her to reach.

Though maintenance may cost substantial money to the school, it may be worth investing in it to have smooth functioning of the computers.

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Software is that part of a computer which makes it work. Without proper software, a computer is like a useless box. A school needs to buy several types of software and the following section discusses some of the important issues involved in choosing it.

### 3.1 What Software to Procure?

What software to use for IT education and technology based lessons will largely depend on the kind of learning the teacher aims to promote (Scrimshaw 1997). For example, a teacher can treat the learners as alert receivers (appreciating external knowledge), interested explorers or active creators of own understanding. If learners are considered as creators, then open-ended software like word processor, database, and graphics packages can be used. Programming languages also assume that students will define their problem, collect data, and process them. When readymade CDs are used, the user is considered as an interested explorer as he/she can explore through the material and learn on his/her own. Power Point-based lessons are meant for alert receivers. Fieldman (2002) argues that using software that meet instructional objectives enhance problem solving skills and higher learning of students. Interactive quality of the technology contributes to its effectiveness. Therefore, it is important to choose software to match the instructional objectives of the teacher and learning capabilities of the student.

Similarly, software required for aiding the administration of a school needs to be chosen carefully and it must also suit the needs of the school. This chapter focuses on choosing software for instruction in schools. Chapter 8 deals with more details about software for administration.

### 3.2 Types of Software

There are various types of software available in the market. But schools need to expose students to some only. It is then assumed that depending on the requirement, students can later learn to handle other types of software on their own or with help from the vendors or other experts.



### 3.2.1 Standard Software

Each school has to procure standard software like:

- Operating system (for example, Windows)
- Office suite (for example, word processor, spreadsheet, presentation graphics, database management, and e-mail software)
- HTML editor (for example, FrontPage, DreamWeaver)
- Desktop publishing software (for example, PageMaker, QuarkExpress)
- Graphics software (for example, CorelDraw, Photoshop, Illustrator, etc.)
- Authorware
- Compilers (for example, LOGO, C, C++, Visual Basic, and Java)

#### Box 3.1

##### What is authorware?

Authorware is an authoring software that allows a teacher to create computer-based lessons by integrating text, graphics, audio, and video. The user can move back and forth while looking at the material. It provides more features and facilities than PowerPoint.

### 3.2.2 Specialized Software

Schools also can procure special software like Mathematica (mathematics software), MapInfo (GIS software), and SPSS (statistical software). These are specialized software meant for special uses. For example, using Mathematica one can solve mathematical equations, draw graphs for equations, and perform many advanced activities. Though students may not need the extent of sophistication provided by them, but some basic exposure to such software can make the subject interesting.

### 3.2.3 Utility Software

The software which provides assistance to basic housekeeping jobs like backup and virus handling, etc., is referred to as utility software. This includes Nero which helps in copying data file and even audio-video files to a CD. There are also anti-virus software that either prevent virus programs from getting into the PC or helps remove those which have already infected the computer. Besides, there is firewall, a software that prevents external intruders from entering the network.

### 3.2.4 Educational Software

Internet and multimedia can provide students with active learning experiences and help them understand abstract concepts better (Ranjan and Arul 2001). A study by Issa et al. (1999) showed that multimedia-based, self-paced learning offers distinct advantages over traditional, instructor-led classroom learning both for high school and university student groups. Thus, schools need to procure several computer-based tutorials (CBTs) or multimedia CDs on different subjects, besides reference CDs like encyclopedia (for example Encarta). While buying educational software, the principal needs to ensure that the CD or CBT has the appropriate content. According to Balsubramaniam (2002), the contents of CDs should coincide with socio-cultural settings of the country/place where it is used, curriculum objectives, and degree and type of teacher training. Unfortunately, most of the good CDs that are available today are imported from abroad and therefore do not match the Indian context and requirements. However, several Indian companies like NIIT are now producing CDs which are of good quality and are worth exploring. Schools can also increase their own efforts and encourage teachers to prepare multimedia lessons for classroom use.

#### Box 3.2

##### Criteria to be kept in mind while choosing educational software

- Should be relevant to the subject being taught in class
- Interactive
- Interesting
- Accurate
- Match the Indian context
- Provide an opportunity to explore
- Allow the student to proceed from easy to difficult concepts
- Flexibility in choosing what to learn
- Provide for evaluation of effort and mastery

### 3.2.5 Simulation Software

Simulation software are a special category of educational software. According to Encyclopedia Britannica, simulations are 'in industry, science, and education, a research or teaching technique that produces actual events and processes under test conditions.' Simulation has the following 3 advantages over real situations: (<http://www.techknowlogia.org>, July–August, 2000)

- **Safety:** Simulation of a nuclear reactor is obviously safer than the real one.



- *Simplicity, ease, and time compression:* Real experiments may be complex, call for more effort, and time consuming.
- *Economy:* A frog dissection through simulation is cheaper than cutting real ones.

Simulation software is best for teaching problem solving abilities. For example, one can acquire fairly extensive knowledge on how to control a plane by using Microsoft's Flight Simulator software. Similarly, SimCity is good for learning how to manage different activities in a city. It was found that students learning computer networking through a simulation software like NetCracker Technologies, scored higher than those using traditional network-diagramming tool like MS Visio (Branigan 2003).

### 3.2.6 Expert System

Expert systems are designed using artificial intelligence constructs. According to Spencer (1999), artificial intelligence that can learn from earlier experiences and develop new rules and strategies can make tutorial packages more effective than human teachers. One can even have a personal tutor. Intelligent tutor systems are now being used to teach complex proofs of geometry at college level. It can be assumed then that expert system-based software can also be useful for school students. However, building them according to relevant needs are expensive and require extensive efforts.

### 3.3 Software Licensing, Copyright, and Piracy

In case of software, the user does not actually own the product; rather he/she gets the permission to use it for a specified period of time. According to copyright rules, an organization must buy multiple copies of the software, equal to the number of machines installed. In some cases, schools may need to pay for annual license to use the installed software. Though this may be a very expensive rule/arrangement, but if not followed, it may amount to engaging in piracy. Some software vendors provide machine or site/campus license, which are cheaper than buying the required number of copies. Schools must explore this option to prevent being accused of software piracy.

### 3.4 Sources of Low Cost and Free Software

Most educational and standard software have to be paid for and are quite expensive. But today, it is possible to have the required software for a lower price.



### 3.4.1 Shareware and Freeware

Internet is a good source to download freeware and shareware. The former can be used and copied by anyone. However, in the case of latter, if the downloaded software is found useful, a small pre-specified fee has to be sent to the author of the software. Normally shareware is a professional program with full documentation. Its publishers also provide free technical support for three months. PKZIP is a good example of shareware.

The material available in such software ranges from tutorials and lessons on various subjects like science, mathematics, english, etc., to useful software tools and school management software. Schools can use these resources instead of buying expensive software. However, before using them, one needs to evaluate the quality with respect to both content and interface since many of these are efforts of a single individual, are exploratory, and have not been subjected to any quality audits.

### 3.4.2 Open Source Software

This is the software for which even the source code is available free. It allows organizations to customize the software as per their requirement. Linux has become successful as an open source software (OSS). There are open source software equivalent to almost all major Windows based software. In USA, many schools are experimenting with open source software to reduce expenses on technology. There are now some welcome trends that will make the use of OSS easier for schools. For example, IBM in collaboration with some universities in Europe has come up with a light weight Linux that can work on old computers (<http://www.136.ibm.com/developerworks/linux/>). SchoolForge (<http://www.schoolforge.net>) acts as a clearing house of information on open source software. Schools can also browse through many Indian sites (<http://www.lincds.com>, <http://www.linuxplaza.org>, and <http://www.linux-india.org>) for more information.

However, to shift from proprietary to open source software, a school has to adopt a clearly defined road map. Box 3.3 is a pointer to this.

The principal has a varied and rich range of software to choose from. However, as in the case of hardware, software must be chosen to meet the needs of the users and the school. This would be defined by the instructional needs of the school which are best known to the principal.

The second most important criterion is the cost factor. Software can be prohibitively expensive and thus must be chosen and bought with adequate thought. It is advised that parents of some children in school who are IT professionals, may be involved in such decisions rather than merely depending on the vendors as is the usual practice. The possibility of using shareware, freeware, and open source software also must be explored.

**Box 3.3****Adoption of OSS in schools: A road map**

Can schools really jump into adopting OSS overnight? The answer is—not really! It is possible that several road-blocks, like the ones described below, would be faced by the school in introducing OSS:

- Adopting OSS is a paradigm shift. It needs understanding of the philosophy behind it and calls for a change in the mental set up.
- There are many misconceptions about the use of OSS. This makes potential users unsure about it.
- As there are hardly any schools which are using OSS already, the ones who would adopt it will have very little support to fall back on.
- Except Red Hat there are no organizations that can extend organized support.
- Boards like CBSE have included MS Office or FoxPro in the IT syllabus as programs that need to be learnt. Thus schools will be apprehensive about the use of OSS as students may face problems in answering questions in the board examination.
- There seems to be a variety of distros (offerings) for Linux and associated software. It confuses users regarding which one to use. Also compatibility between software is an issue.

However the benefits of using OSS are many. The following are some of them:

- It provides an alternative to the expensive proprietary software.
- Unwillingly schools might be involved in software piracy. OSS provides a way out of being involved in illegal activities.
- Senior students in schools can look up the source code of some software and learn how these are actually designed.
- Computer teachers or school software professionals can customize OSS based school management software as per their requirement.
- OSS is less prone to virus.
- As newer versions of Windows require more powerful computers, schools, instead of discarding their old computers, can opt for Linux in their old computers and then continue to use them.
- OSS has the same user interface as the proprietary software and now vernacular language interfaces are also available.

Mohanty and Mishra (2004), based on their field study, offer the following tips to be kept in mind while adopting OSS in schools.

**A. Change over to OSS**

1. The principal of the school has to be really convinced about OSS and should take the lead in implementing it in his/her school.
2. To begin with, schools must realize that an alternative set of software exists, but it may take time to switch over to them. As on October 2002, sourceforge.net was hosting 50,000 open source projects with over 50,000 registered developers (Schamess 2002).
3. Schools must emphasize as much on capabilities gained, as on cost saving aspect of open source software (Lineweaver 2002). The competency level of the teachers and the system administrator increases with their ability to modify and customize OSS as per the needs of the school.

(Box 3.3 continued)



*(Box 3.3 continued)*

4. The next set of people who need to be comfortable with OSS are the computer teachers in the school. While the use of OSS may not require new skills (as long as you know how to click and use Windows based software), because of graphical user interface, proficiency is required for installing Linux and other associated software (Lineweaver 2002). Thus, one or two computer teachers have to be trained in installing OSS. The principal has to use multi-pronged strategies to motivate one or more computer teachers to acquire required skills in software installation, otherwise temporary outside help should be sought. It may be noted that while there may be a mental block for people who have been using proprietary software to shift to OSS, this dilemma will not arise for students who will be using computer software for the first time.
5. Initially, the school may opt for hybrid model where at the time of booting, one has the flexibility of indicating whether one wants to use Linux or Windows environment. Alternatively, a large Linux lab and a smaller Windows based lab can be opted for: Riverdale High School, Portland, USA opted for both the environment in order to expose students to multiple operating systems (Schamess 2002).
6. Schools can opt for OSS till class VIII and then in higher classes, students may be asked to explore Windows environment on their own as part of assignments/projects. As the learning curve for users to switch over from one to the other environment is really small, students would face no problems.

**B. Extent of the usage of OSS**

7. Computers are used in schools in three areas: teaching IT, teaching other subjects through IT, and school management. Schools can first adopt OSS based school management software, then use OSS in teaching/learning, and finally move to IT teaching. This sequence will have the least resistance as the student community will be the last to get exposed to the change. However, the road map for each school has to be dependent on the skill set possessed by the computer teachers in the school. Use of the school management software may require higher order of skills because of the need for customization while 'teaching IT' may be easy as the software can be used straight away.
8. A fourth area where OSS can be immediately used is to support backend processes of network management and website development and maintenance (Schamess 2002). Apache is one of the most popular web server and is an open source software. Similarly, Perl is an effective programming language for writing cgi scripts for web page development (Irvine 1999). Tools like Sinapse (<http://www.sinapse.org>) can help schools to develop and maintain on-line communities.

**C. Creating a support group**

9. Schools adopting OSS must encourage other schools in the neighbourhood to opt for it so that a critical number of schools use OSS. This can facilitate sharing of information and troubleshooting tips between schools.
10. Schools have to influence their respective boards to replace specific product names with generic product categories. For example, the board can refer to database management software instead of FoxPro and word processing instead of MS Word, etc.
11. There are Linux user groups in most of the cities in India and besides that, there are a lot of virtual groups in the cyber world promoting and supporting OSS. Schools have to be aware of such groups so that in case of trouble they can approach them.
12. An e-group of computer teachers using OSS can be formed to facilitate sharing of information related to OSS.



### Box 3.4

#### OSS implementation in St. Andrews School, Hyderabad

The Emanuel family, in memory of Late Mr Louis William Emanuel, started St. Andrews School in 1987 which is managed by the St. Louis Education Society. This society comprises of like-minded people, who believe in doing their bit for society through voluntary service. This dedicated group set about to fulfill the vision of its founder of providing quality education to many little children of the twin cities, teaching them the right values of Equality, Justice, and Truth. They believed in working towards the mission, 'Education is a Service.'

Today, the school has become one of the largest and most prestigious institutions of Andhra Pradesh with nearly 7,000 students and over 370 teachers/staff.

#### *The beginning*

In the early 1990s, the school had introduced Windows 3.1 along with the prohibitively expensive colour monitors and legal software. As the school started growing, it was felt that OSS would become the software of the future, and so it embarked on yet another path breaking mission by introducing Linux and related OSS in 2005. Mrs Urmila Nair, the Vice President (Administration) made a project report on OSS and with the support of the management went ahead with its implementation.

Extensive preparation had to be undertaken to implement it. The school had to both install the systems and prepare its own computer books, as there were none in the market. The Head of the Computer Division along with her team downloaded the correct version of the software equivalent to the Windows-based software and ensured that all the options worked. Based on the textbooks that were prepared, the following programs were introduced in the school:

- Tux Paint
- Abi Word
- Open Office
- Knoda
- K Turtle
- NVU
- C Programming

The school management allowed the project team to hire data entry operators for the development of textbooks. A parent, who was the editor of a prestigious newspaper helped with the editing work.

Initially, the computer department teachers felt challenged and needed to improve their own technical skills. To make them comfortable with the use of the new software, technical training was held every term followed by an examination for all. It was found to improve their confidence levels. In addition to training, those teachers who had a technical edge over others were also asked to adopt one of the teachers to improve their technical skills on a one-on-one basis.

#### *Advantages for the School*

Introduction and use of OSS helped the school in various ways. Some of them are:

- The school was able to increase the number of laboratories from three to seven and the number of computer systems from 75 to 190, as it did not have to bear the cost of legal software. This enabled children to have more hands-on experience and enjoy practical sessions.

(Box 3.4 continued)

*(Box 3.4 continued)*

- The faculty of computer science designed their own presentations for their classes and learnt to develop case studies and interesting activity documents. The faculty felt that this improved their awareness and teaching skills.
- The teachers learnt to help each other and were motivated by the challenge.

**Responses from students and parents**

The response from both parents and students was overwhelming and in fact, many parents were very enthusiastic to take a copy of Fedora (a free operating system) from school for use at home.

**Challenges on hand**

Though the school has reaped many benefits, still it faces several challenges in its journey to adopt OSS in all its activities. Two of these challenges are:

- The server and other hardware related configurations. The Network Engineer and the Head of the Computer Department were sent for a month long professional training course. They were able to gain a lot of inputs, which has helped them to train the other nine faculties handling various classes. However, several problems still exist and solutions are arrived at by trial and error.
- An area that is still problematic is the usage of Television and LCD projectors for demonstrations and presentations. Both the Head of the Computer Division and the Network Engineer are unable to configure the range mobility AGP card in Linux as a result of which the school is using a dual booting system as a temporary measure.

*Prepared by: Urmila Nair, Vice Principal, St. Andrews School, Hyderabad.*

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## CASE STUDY I

### A Smart School (Swastik's Sattva Vikas School, Ahmedabad)

#### Introduction

Swastik's Sattva Vikas School (SSVS) is an English medium school established by Raja Pathak in June 2003. Mr Pathak has been managing three other Swastik Schools founded by his father, Shri Chandraprasad R. Pathak in 1959, who was an innovative physics teacher and a recipient of the President's award for the best teacher in 1989.

SSVS was a dream project of Raja Bhai Pathak, where he wanted to use technology effectively to make learning fun. It claims to be the first Smart School of Gujarat aimed at eliminating the culture of tuition.

SSVS is located in the Thaltej neighbourhood of Ahmedabad and is 2 km from Gandhinagar–Sarkhej Highway. It is established in an area of 1.2 acre with a carpet area of 25,000 sq ft. In 2003, it had classes upto VII with 22 students and 12 teachers. It planned to affiliate itself to Secondary Board of Gujarat (SBG). This was because students in Gujarat by and large prefer SBG and other Swastik schools were already affiliated to it.

SSVS intended to have only 36 students in each class and only one section per class. It was built and designed to cater to only about 500 students. According to Rajabhai, 'I prefer small student strength as I intend to experiment with many new concepts to make education more effective and interesting. This may not be possible if I have a large school.'

#### Information Technology (IT) Infrastructure

SSVS has been designed to be IT centric right from its inception. By 2003, the school was fully wired with 221 computers in the classrooms and 35 teachers. In each class, there were 12 computers—one for three students. This sharing promoted the concept of cooperative learning. The table was so designed that it also served as the writing and reading table when computers were not used and the screen was visible from the glass top (part) of the table

i.e., the monitor was placed under the table top. The keyboard and the mouse could be pulled out when required while the CPU was kept the bottom of the table. In the nursery class, two computers were mounted on a toy car on which students could sit and use the computers. In the preparatory class room, the computer tables were in the form of some letters like 'A,' 'B,' 'C,' and 'H,' etc. Each teacher was given an independent computer. The computers of the School Coordinator and Principal had flat screens that occupied less table space.

All the computers had Pentium-IV processor with 80 GB hard disk space, CD drive, and a speaker. No floppy disks were provided to prevent computers getting infected by virus. The school had not opted for thin client to enable flexibility of having different multimedia programs in different systems. For example, in all the computers of Class VI, the class teacher could copy the content of two or three selected CDs in the hard disks and ask the students to use them for some time. After a period, he/she could replace those multimedia programs in the hard disks with the contents of another two or three CDs. This would not be easily possible if all the computers in the class rooms had no hard disks and depended on the server. The school had a CD juke box that could hold 12 CDs at a time and connected to the server which were used by students. All the computers had been purchased from local assemblers. There was a network administrator to look into the maintenance of the network in the school.

The 64 Kbps Net connectivity was through ISDN lines from BSNL. Students' computers were not given any net connection as the promoter of the school believed it would be difficult to keep track of misuse, like visiting unwanted sites, even if the firewall software was installed. CAT-6 cables were used for networking. There was a separate switch room for the School LAN. Wireless LAN was not opted for, as it was felt that multimedia content would be heavily used and that might slow down the throughput in a wireless setting. A 30 KVA stabilizer had been installed to provide stable power supply.

The School had bought several programs like 'wired school' from the service provider (classteacher.com). It used software designed and developed by its own management team. The library planned to have 16 multimedia computers with Net connectivity which students could use for project work and which would also be used to teach language skills with emphasis on listening skills. The school also intended to initiate virtual project team concept where students could collaborate to do projects with schools in other countries.

In 2003, the school did not have any audio-visual room, but it intended to buy some LCD projectors and develop facilities for students to present their project work.

## Use of Computers

Every day a student used computers roughly for one-and-a-half hours and its use for each subject was scheduled in the timetable.

In preparatory classes, students did more listening as they tried to learn the language by listening to stories and poems. It was expected that by the time a student finished class XII, he/she must have read at least 600 books and must have written book reviews for a



certain number of them for which they could use a computer. The school also intended to use each computer in the class as a language lab where students could use language CDs and improve their accent and pronunciation.

Teachers used computers to set e-tests, analyze the performance of students in those tests and carry out other tasks. Initially the teachers went through a 15 day computer awareness program whereby they picked up skills such as surfing the Net, word processing, scanning, and using PageMaker and PowerPoint. Other than that, there had been no formal training programs for them. Each teacher was expected to surf the Net for at least 10 hours in a week. They could do so in cyber cafes near their homes, for which the school reimbursed the cost. In fact, teachers could download useful websites, get them written on a CD and submit the bill to the school for reimbursement.

## Processes

SSVS used the concept of competency designed by Gujarat Board of Secondary Education. Under this, a subject could be divided into various sub-topics with several competencies, e.g., listening, reading, writing, and speaking. Each competency for a subject, and for a class had a unique code of reference. For example, 1.1.01 referred to first level listening for class I. When a student was asked to take an e-test, he/she was given the code of the competency for which the test had to be taken.

Competency Marksheet was an innovation that Swastik School had brought in. A student was tested for several competencies for a subject and though he/she might have got an overall percentage of more than 80, the same might not be the case with the competencies. In that case he/she was declared not passed in those competencies. The student had to achieve 80 percent on all competencies for the subject.

When the aggregate scores of all students was ascertained for a subject by a teacher, if a certain number of students had not passed in a certain competency, the concerned teacher was suggested by the computer program that generated marksheet to either teach that competency again or give five more worksheets. This marksheet helped the concerned teacher to focus on certain competencies for a subject in a particular class. In addition to student competency marksheet, a 'Teachers Marksheet' was also generated.

Students were expected to check their e-mail in the morning on a typical day (These were internal and would come from teachers and school management. A student could not use this facility to either send or receive mail from any outsider). Teachers used e-mail to direct a student to take a test on a particular competency. The student using the computer took the test and immediately he/she was informed about the score. In some e-tests he/she was given pictorial information about the concept. For example, if he/she was asked about two cities of India, then a map of India showing those two cities with some additional information was displayed, before asking related questions.

Each day, there were one or two practice periods for the subjects taught in a class. For example, on Monday there could be a practice period for mathematics for class VI, while on

Tuesday, it was for social studies. Each was for a duration of 25 minutes. 50 minutes was devoted for a concept period. CDs related to the subject were available for the practice period.

Teachers used CDs that were procured by the school to teach subjects. They also downloaded entire sites from the Net using software like Webcopier and used them in the offline mode in class. It was planned that teachers would start preparing some lessons on their own in the near future.

According to Rajabhai, his school was perhaps the only one where a topic was taught at least 20 times. What he meant by that was, once a subject was taught by a teacher, the concept was reinforced by several methods, all using technology, so that the student was finally thorough in it. For example, after a topic had been taught, a student took an e-test, looked at some materials on the CD related to that topic, and carried out an activity related to the topic.

## Founder

Rajabhai Pathak was quite IT savvy. He surfed the Net for about six hours every day to search for interesting materials that could be used by teachers or students. He purchased e-books that he found valuable for students and teachers online. Besides, he was well versed in using word processor, scanning, and making PowerPoint presentations. He had learnt all these on his own. He believed that if someone had access to a computer, he/she could learn the basic skills without any formal training. His first encounter with the computer was in 1988 when his father bought a Suvik computer that was very expensive (more than a lakh). He hoped to enthuse teachers about IT and its use by being a role model himself.



In this chapter, curriculum issues related to IT as a subject and ICT as a tool to teach other subjects will be discussed. The opinion on the usefulness of ICT's in the classroom is not clear. According to Clark (1983), 'consistent evidence is found for the generalization that there are no learning benefits to be gained from employing any specific medium to deliver instruction.' Spencer (1999) argues that only when coupled with proper learning strategies, a medium can be effective. The assertions of Clark (1983), Spencer (1999), and many others emphasize that mere use of ICT in education is not sufficient to make education effective.

A simple example can illustrate this. To explain the concept of 'force,' a teacher can use a table in the classroom and push it forward rather than trying to use complex multimedia presentation. But, to illustrate 'projectile movement,' a multimedia presentation can be made use of. It is easier to show how the use of more force or throwing at different angles changes the shape of the projectile movement. This cannot be explained effectively even by throwing a ball in the field. Similarly, a teacher cannot effectively show how two bones are joint or how they move against each other without using an animation clip. Thus, classroom teaching can be complemented using such video clips available from companies such as Jindal Informatics Ltd., and Eureka. Such usage of technology empowers the teachers and exploits its power in the best possible way.

There must be an appropriate change in the way education is imparted with the introduction of technology—decisions such as what to teach, how to teach, and even where not to use technology need to be made by the principals and teachers. The ultimate goal of making teaching and learning effective has to be always kept in mind and appropriate tools to improve the learning process needs to be chosen.

## 4.1 Teaching Information Technology

IT can be taught in three ways: discrete, cross-curricular, and hybrid. In discrete or subject IT, a course called computer science is offered like any other subject, where students will be taught about IT and then their knowledge in the subject can be assessed.

In cross-curricular approach, IT is taught as part of other subjects. Herein, IT can be assumed to have some sub-themes and each can be handled by a particular subject. One possible arrangement is:

- Communicating information sub-theme—English
- Handling information sub-theme—Geography
- Controlling sub-theme—Science
- Modeling sub-theme—Mathematics

This arrangement can be administered easily. However, a subject teacher may not be competent enough to handle the IT component and may also perceive it as an extra burden. To overcome this, the IT aspect can be handled by teaming an IT teacher to teach with the subject teacher. However, team teaching requires much coordination and it is the principal's role to train teachers to teach as a team and create a culture of collaboration in the school.

The third approach is using the hybrid model. In this, two sub-approaches can be used: kick-start and skill core. In the former, fundamentals of IT can be taught as a subject in the earlier classes and then cross-curricular approach may be followed in higher classes. In the latter, in all classes, a separate subject called IT can be offered to impart basic skills that are needed for other subjects. Specialist teachers can teach IT and evaluate students for IT skills. The subject teachers are to be left to use IT to teach their topics.

#### 4.1.1 IT Syllabus

One of the major areas which needs serious deliberation is the curriculum for IT education. The changes in the information and communication technology are fast paced. This makes it necessary for schools to balance between teaching of fundamental concepts and the ever changing IT skills. IT syllabus, like that of any other subject, needs to be designed keeping in view the cognitive ability of the children and its ability to meet the demands of the changing world where students will work and live (Keen 1992).

Results of Becker's longitudinal study (1994) with respect to IT topics taught in schools in the USA and the possible logic for choosing the same are summarized in Table 4.1. It is evident that topics were chosen on the basis of their popularity or some other logic rather than their appropriateness in the overall curriculum framework. For example, in the late 1980s the bulk of IT education was based on programming, but currently, HTML is likely to be taught as it is the most popular. Indian schools seem to have followed a similar pattern as the schools in USA in choosing topics to be taught in various classes.

The skills imparted by various facets of IT teaching vary, for example, traditional programming languages teach problem solving skills (Salomon and Perkins 1987), unlike application software such as HTML. Kennewell et al. (2000), argue that though multimedia software



allows students to explore, hypothesize, and evaluate information, still there is a need to devise a sequence of instructions to achieve a particular goal. Thus, schools should emphasize on programs such as LOGO which has the ability to teach students how to give precise instructions.

**Table 4.1**  
Becker's observation regarding IT topics taught in US schools

| <i>Year</i> | <i>Topic</i>               | <i>Becker's comments about the philosophy behind the topic</i>                                                                                                                                                                                                                                   |
|-------------|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1982        | BASIC                      | Programming is the basic skill for the 21st century. Teach students to program using the BASIC language that comes with their computers.                                                                                                                                                         |
| 1984        | LOGO                       | Not BASIC—for heaven's sake! Teach students thinking skills that will transfer to non-programming situations. Teach students LOGO!                                                                                                                                                               |
| 1986        | Lesson Management Software | Let's stop playing around. Declining test scores are symptomatic of a major problem in academic achievement. Computers are wonderfully forgiving tutors, and with multi-layer sequences of programs, and integral lesson management software, students can all work at their own level and pace. |
| 1988        | Office Software            | Don't treat students as objects to be stuffed with information. Students should use computers as tools like adults do—they should learn how to use spreadsheets, database programs, and word processors.                                                                                         |
| 1990        | Subject related software   | Tools are for adults? Make the tools relevant to the schools' subject-matter goals. If it's not integrated with the existing curriculum, it's not useful.                                                                                                                                        |
| 1992        | Multimedia presentation    | Active learning—learning by producing a marketable product for a real audience—that's the only learning that lasts. Having students program hypertext multimedia interactive presentation is therefore one of the most valuable educational use of technology.                                   |
| 1994        | Internet                   | Let students be part of the real world.                                                                                                                                                                                                                                                          |

Teachers must relate to other subjects while teaching IT topics. For example, while teaching programming, problems from mathematics, geometry, and other subjects can be solved to reinforce the understanding in those subjects. It would help the child to connect one subject with another. Bellack (1969), also emphasizes this concept—she says that one must not only look into a subject independently, but must also explore connections with other subjects while designing the curriculum.

A suggestion with respect to the underlying philosophy for designing the IT syllabus is that 'skills' could be taught in the junior classes while 'concept' may be stressed in senior classes. Students should also be exposed enough to hardware concepts so that they are comfortable with the machines. They should be able to address minor hardware problems and carry out preventive maintenance chores.

Another guide is to find out the minimum skills that a student must have in IT. The syllabus must be able to find ways of helping students acquire those skills. Pelgrum (2001),

has prescribed following minimum skills in IT that students need to acquire by the end of their school term:

- Operating a computer (saving files, printing, keyboarding).
- Writing documents with a word processor (typing, editing, layout).
- Making illustrations with graphical programs.
- Calculating with spreadsheet program (sheet creation, using formula).
- Writing simple programs (LOGO, C).
- Sending, searching for, and using electronic form of information.

Box 4.1  
Deliberations for IT syllabus

Meet minimum skills

Teach skills and concepts in a certain progression

Be linked to the learning abilities of the child

Be linked to the other subjects taught in the year

Address the needs of the learner

Enable to reach the agreed teaching-learning goals

Remain contemporary

Be able to justify teaching of a certain topic

#### 4.1.1.1 Uniform IT Syllabus?

An issue worth considering is—should schools follow a uniform syllabus? It has been observed that the board (CBSE/ICSE) sets the syllabus for the final examination and the schools design their own for IT for various classes using the board syllabus as a guide. Depending on the understanding of the computer faculty and personal preferences, the syllabus can vary from teaching one topic during the entire year for a particular class (for example, only teaching MS-Word) to teaching a combination of skills and topics in the same year. Now that NCERT has come up with a suggested syllabus from nursery to class XII, a relevant question that can be raised is—should schools follow a standard syllabus or experiment with pedagogical tools? This is a topic worth debating among the teachers and the principal of the school. There are pros and cons in each of the approach. The principal need to consciously decide to ensure that the decision is in line with the overall teaching goals of the school.

#### 4.1.2 Pedagogy

The content alone is not sufficient. Therefore, a number of pedagogical tools have been developed by educationists to teach courses effectively. For a fast changing subject like IT, teachers must adopt other pedagogical tools apart from the 'talk and chalk method.'



Duckworth (1996) claims that a project-based curriculum improves the environment for learning in schools. It gives students a spectrum of opportunities to build up their strength and confidence as learners. Teacher's remarks on a project aids further learning. (Sandholtz et al. 2000).

It was just gratifying to see that as soon as one student finished, they would go look at another student's, saying, 'How did you get to do that?' They shared strategies. 'Didn't you do that extra credit?' 'You know how to do square root? Let me show you.' It was just that sort of give and take, that sort of excitement, contagious enthusiasm, high level of engagement that makes me feel that this really is a good model for the classroom of the future.

Besides projects, other pedagogical tools that schools can use are:

- Multimedia lessons
- Projects
- Visit to industries
- Group discussion
- Student seminar
- Poster making

A July 2002 study by Pew Internet and American Life Project (<http://www.pewinternet.org>) showed that students wanted more engaged assignments and work that were more relevant to their everyday lives. Internet based projects are able to satisfy such needs of children. But, they are likely to encounter the following hurdles—lack of quality access to Net, blocking and filtering software that stop even genuine sites to be shown, and lack of efforts on the part of teachers to combine the use of Net in various assignments.

Some schools have set up a Computer Club (e.g., MINET in Mother's International School) that not only provides training on higher level skills, but also allows the students to maintain a school Website, design and develop some application for schools, bring out e-zine, etc. (discussed in detail in Chapter 7). This concept of computer club adds to the learning of IT by students.

### 4.1.3 Related Issues in Use of Computers in Schools

Some of the issues concerned with the use of computers that may look minor, but worth resolving are:

- *Should students be allowed to play games?* Many a times the question arises whether students should be allowed to play computer based games? Many schools are strictly

against it, because they are addictive. But research has shown that games can enhance visual ability of students and can attract them to computers more than anything else. Thus, strategically students may be allowed to play games as an incentive for finishing their part of the assignment. This in turn may initiate them to the world of computers.

- *Typing skill important (Typing Tutor)?* Though many adults manage their word processing needs on computers by using the pick-and-peck method, it makes sense if students are allowed to learn proper typing skills. This can enhance their productivity while working on large documents.
- *Should marks of computer subjects be considered?* In some schools, grade cards do not carry marks scored by students in IT. According to many computer teachers, this deters students from taking an active interest in the subject. Though there are various methods to generate student's interest in a subject it cannot be denied that marks are an established motivator and so may be used as a means to make students take the subject seriously.

## 4.2 Teaching with Technology

Today Indian schools are shifting the focus from IT education to ICT assisted teaching. This is a field where ICT is going to make a bigger impact and principals need to put more efforts in this. Box 4.2 presents the shift in the role of students and teachers in the classroom. The onus of learning has moved from the teacher to the student. The latter has to learn by exploring and also by working with peers. The role of the teacher is not to provide information but guide students to find required information. Both teachers and students need to become co-learners. In this shift of teaching-learning process, technology can play a major role.

Box 4.2  
Old and new models of teaching

| <i>Old method of teaching</i> | <i>New method of teaching</i> | <i>Technology implications</i>                 |
|-------------------------------|-------------------------------|------------------------------------------------|
| Class room lectures           | Individual exploration        | Networked PCs with access to information       |
| Passive absorption            | Apprenticeship                | Require skills development and simulations     |
| (Action/active learning)      |                               |                                                |
| Individual work               | Team learning                 | Benefits from collaborative tools and e-mail   |
| Teacher as dispenser          | Teacher as a guide            | Access to experts over the network             |
| of information                |                               |                                                |
| Stable content                | Fast-changing content         | Requires networks and publishing tools         |
| Homogeneity                   | Diversity                     | Requires a variety of access tools and methods |

Source: Maier P, et al. 1996. *Using Technology in Teaching & Learning*. London: Kogan Page Ltd.



Tools like search engines can facilitate exploration of information. E-groups can encourage discussion between large number of people. Websites and blog sites (blogging is discussed in Chapter 10) can help disseminate information, ideas, and thoughts. School principals need to be aware of these tools and establish systems to derive benefit from them.

### 4.2.1 Advantages of IT Assisted Teaching

According to research, the following are the advantages of IT-assisted teaching over traditional classroom teaching:

- Learners are able to access high-quality teaching and learning at any time and place.
- Information previously available only through a professor or an instructor is accessible on demand through computers and the Internet.
- Well-designed multimedia learning materials can be more effective than the traditional classroom methods because students learn more easily and quickly through illustrations, animation, different structuring of materials, and increased control of interaction with learning materials.
- New technologies can be designed to develop and facilitate higher order learning skills, such as problem solving, decision making, and critical thinking.
- Interaction with teachers can be structured and managed through on-line communications to provide greater access and flexibility for both students and teachers.
- Computer-mediated communication can facilitate team teaching, use of guest faculty from other institutions, and multicultural and international classes.

According to Barron and Orwig (1993), the prudent use of technology in education extends the following benefits:

- Multi-sensory education
- Increased self-expression and active learning
- Cooperative learning
- Communication skills
- Multicultural education
- Student motivation

According to Davis et al. (1997), ICT provides an alternate source of knowledge and information and teachers can therefore be free from managing classrooms to concentrate on enhancing the quality of learning experience for students. This leads to more qualitative communication between the teachers and the students thus blurring the line between them.

Holvig and Crisci (2001) provide the following evidence in support of positive impact of the use of technology:

- Empowerment: Students feel more power in hand.
- Engagement: Students get to collect data and analyze them.
- Authenticity: Students feel that technology has helped them.
- Leading with technology: Students feel technology will give them an edge in the latter part of their life.

Visits to some of the leading schools in Delhi and other cities showed that Intel's 'Teach to Future' program for school teachers had brought forth a lot of positive energy in those schools. Teachers were able to use multimedia and PowerPoint and prepare presentations on some of the topics they taught. They felt that presentations made their teaching more effective.

## 4.2.2 Obstacles to ICT in Education

Some research findings also show that there is no conclusive proof of computer-based learning (CBL) making the teaching and learning process more effective than conventional processes. CBL, for example, does not allow students to inquire about unrelated information.

A worldwide survey of representative schools in 26 countries by Pelgrum (2001) showed that ten most important obstacles to integration of ICT in education are:

- Insufficient number of computers.
- Teachers lack knowledge/skills.
- Difficult to integrate query in instruction.
- Scheduling computer time.
- Insufficient peripherals.
- Not enough copies of software.
- Insufficient teacher time.
- Not enough simultaneous access to World Wide Web (WWW).
- Not enough supervision staff.
- Lack of technical assistance.

These impediments highlight the importance of providing adequate hardware and support facility for getting the best out of the use of technology in teaching-learning processes.

The use of technology sometimes looks positive when it is introduced because of its novelty. The initial enthusiasm may not sustain for long unless teachers understand its



most effective use. The principals need to appreciate these realities and guide the process of use of technology in teaching in a much matured and systematic way.

### 4.2.3 Designing IT Assisted Curriculum

It has been found that CAL (Computer Aided Learning) improves learning only when it:

- Identifies a real pedagogic problem.
- Is accompanied by a pedagogic theory of how an educational intervention is a solution to the pedagogic problem.
- Is a good example of CAL design (better human interface).
- Involves skilled administration of teaching and learning using technology.
- Is accompanied by evaluation and demonstration of the resulting learning gains.

While designing IT driven curriculum, we may have to discard old assumptions and choose new realities. Vaughan (1997) showed that though normally it is believed that small kids cannot handle large numbers, using computers they are shown to be comfortable even with three-digit numbers. Such findings compel us to look at the curriculum content and modify, if required, to suit the requirements of a particular age group or grade.

CBL should not be seen as a total replacement of lecture, workshops, and formal laboratories. Rather it can act as a reinforcement of concepts taught in lectures (Rowe and Gregor 1999). Students find it as a novel method of teaching and it also gives them a sense of power. At the click of a mouse, they have access to audio, video or further information. The interactivity of CBL motivates students to opt for problem solving. Yelland and Masters (1995) worked with Turtle Math (LOGO) to show that if students can be engaged in exploration, and discuss their findings with others, they not only find the whole process interesting, but significant learning also occurs. The CBL must also have a good design in terms of user interface for it to be accepted by the students.

Appendix A provides three lesson plan samples for using IT resources for effective learning. Schools must use a comprehensive plan for using technology in teaching/learning.

Draper (1998) adds that a computer-aided learning (CAL) software is successful only when it removes a bottleneck that exists in handling a course or a topic. For example, teaching a foreign language may require long hours of conversation practice. Providing human teachers may be costly. But, a software can provide the context to students, record their conversation, and play it back to them later. That way a student can understand where he/she went wrong and how to rectify mistakes.

In teaching with technology, issues about selection of pedagogical methods also become important. The use of old methods does not really exploit the benefits of technology. For example, in a didactic lecture where acquisition of information is the main objective, the

use of technology can make the process interesting, but it may not improve the performance of students. Thus, research must be undertaken on how to employ technology to make it effective. In fact, action research can be undertaken to find appropriateness of the techniques and processes used.

#### Box 4.3 Evaluating use of technology

The following questions may be asked to evaluate the use of technology in teaching:

- What impact will this application of technology have on student-access and flexibility to learn?
- What are the cost advantages and disadvantages of applying this technology?
- What teaching functions and learning outcomes seem to be more easily or effectively achieved through the use of this technology?
- What forms and levels of interaction can be achieved using this technology?
- How easy is the technology to operate and manage?
- How reliable and stable is the technology?
- How quickly can courses be designed or materials developed using this technology?

#### Box 4.4 IT implementation in V. S. K. Memorial High School, Hyderabad

V. S. K. Memorial High School was founded by Sri A. Radha Krishna Murthy, a chartered accountant in the year 1986 in a sub-urban area (Kukatpally) in Hyderabad. The school had a strength of about 65 students at the time of inception. Mr A. V. L. N. Swamy, an engineer and Mr K. Bhaskar Reddy, postgraduate in economics and tech-savvy joined the management team in the year 1995 and 2004 respectively. They both wished to have a school where IT was used in classroom teaching, learning process, and school administration.

##### **Implementation of IT strategy for school development**

The management team applied a phase wise approach for the implementation of using IT as a strategic tool in school development.

##### **Phase I: Preparatory Stage (1997-98)**

In the year 1997-98, the management took a strategic decision to use IT as an effective tool in classroom teaching. The major challenges were the readiness for change in the teachers and their skills, as none of them were trained in IT. The problem was intensified because of budgetary constraints imposed by low fee structure of the school.

CBTs (Computer Based Training) were used for selected lessons in science and english in the first year and demonstration classes for students and teachers were regularly held to get everyone convinced about the advantages that CBTs could bring about in classroom teaching. The school also procured four computers on hire purchase

(Box 4.4 continued)



(Box 4.4 continued)

scheme to demonstrate lessons to students. Teachers were sent to attend seminars conducted by NIIT LEDA to develop understanding and appreciation of technology usage.

#### **Phase II: Introductory Stage (1998-2001)**

During the next three years, the school signed up with NIIT LEDA program for classes KG to IV and invested in the software and teachers training on the use of education software for these classes. Four more computers were added and the lab was used for teaching IT and also for learning other subjects. Teachers handling science, english and maths were asked to identify lessons for IT enabled subject teaching. The school had a strength of 430 students and 19 teachers at this stage.

The school also enrolled for the Intel's *Technology in Education Program* and rewarded the teachers who participated and utilized their skills in the usage of IT in classroom teaching. It also received special appreciation from Intel team for its commitment and implementation efforts.

#### **Phase III: Integration Stage (2001-04)**

By this time, the teachers were comfortable in using education software and were also trained in basic IT skills. Now the management's focus was to develop a system for complete integration of IT into teaching and learning processes of the school. The school signed an agreement with School Net for classes KG to VII for the next three years wherein the teachers handling science, english, mathematics, and social sciences were sent for basic level training and from there, they also obtained education software covering large number of topics in those classes.

Separate sessions were conducted to map the topics included in the syllabus and CBTs available in school. A reward system was created for teachers who were engaged in effective usage of the software. The number of computers was increased by 20 and two classrooms were equipped with computers connected to a 29 inch television.

Steps were also taken to introduce computers for office automation work and for the generation of student performance reports.

#### **Phase IV: Effective Utilization of IT for School Development (2004-06)**

By this stage, the school strength increased to about 1,000 students and 40 teachers. It signed with School Net<sup>1</sup> for KG to IX and enrolled more teachers for the training program. The school also introduced the Double Click<sup>2</sup> program of School Net for IT education. Some of the teachers also went through advanced training program.

The implementation was made more effective by identifying the technology usage areas at the lesson planning stage with the help of School Net. The school signed up for classroom observation whose educators sat through classes and later provided personal feedback to teachers. The teachers also participated in project presentation

(Box 4.4 continued)

<sup>1</sup> School Net was the education division of ILFS (Infrastructure Leasing and Financial Services) which was set up to enhance quality of school education. Later it was renamed ETS (Education and Technology Services) division.

<sup>2</sup> Double click is a program where support is extended towards how to teach IT in schools and how to integrate IT with other subjects.

(Box 4.4 continued)

contests meant for teachers and students. They bagged prizes amongst the top schools of the state of Andhra Pradesh and in 2006, they utilized IT even for development and revision programs for slow learners.

The school invested in buying a K-YAN<sup>3</sup> and developed an AV (audio-visual) room. A system had been devised for monitoring K-YAN utilization, and technology implementation. This team comprised of Vice-Principal and a few teachers. High usage was rewarded with financial incentives.

The teachers and students were provided with Internet connectivity everyday for a few hours to do some research and find material for project work. The students, teachers, and management started utilizing IT not only for effective learning, but also for various presentations, PTA meetings, academic planning, administrative aspects, and faculty development programs.

### **The Road Ahead**

The school is focused on the following for the next three years:

- Provision for more online classrooms.
- Availability of Internet for more number of hours with adequate controls on its appropriate usage.
- Installation and use of complete school management ERP software.
- Developing new rewards and incentives model for the effective usage of IT among students and teachers.
- Developing a mechanism for using IT for testing and personalized learning.
- Utilizing IT for better parent communication and brand building of the school.
- Identifying a funding agency to support the school initiative in IT use.

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## **4.2.4 Miscellaneous Issues Related to CBT**

There are several issues related to computer-based learning and they need to be resolved.

- *Guided or self-learning?* Some CBTs can be focused on self-learning where students need to go through those CBTs and learn at their own pace. Others may require teachers' intervention. Do we need to choose a particular type? Considering the functioning of a typical school, guided CBTs should be used to introduce students to the topic and then students may be given self-learning ones to work on during their leisure time or at home.
- *PowerPoint or VB based?* Many school teachers use PowerPoint to develop lessons. Some have opted a different method where teachers design the lessons, but programming (or developing using other specialized software) is undertaken by professionals. The question to be resolved is, which one should be opt for? In general, one can

<sup>3</sup> K-YAN is a device developed by IL & FS ETS. It is a computer and LCD projector put together. One can show PowerPoint presentation, films and play music.



choose the PowerPoint option as it is easy and simple. However, if a school wants to develop lessons that need to have an assessment component or a professional look, the second option may be chosen. The Case study of Apeejay School illustrates the exercise of the second option.

- *Is it reinventing the wheel?* As there are many vendors developing multimedia-based lessons, it might be asked, why should school teachers get involved in developing lessons? Isn't it like reinventing the wheel? Even if it is true that reinventing is not necessary, in order to learn and appreciate the technology and its implications, every teacher must be encouraged to develop at least a few lessons. However, schools also must develop mechanisms to share their prepared lessons with other schools and they should make use of professionally prepared lessons to complement their own efforts. For those teachers putting in extra time to develop technology based teaching materials, some honorarium may also be paid (Bates 2000).

#### 4.2.5 New Avenues for Student Centered Learning

As already discussed, there is a shift in the process of teaching and learning, and technology opens up many avenues in this regard. For example, there are websites/CDs that provide a virtual tour of the zoo, the museum, and many other places which students can explore on their own. This is the best alternative to real visits. In the software section, we have discussed simulation which is a powerful tool. Today, even pilots are trained on the simulation software before practicing on the actual planes. The flight simulator program from Microsoft is a great learning tool. Students can even dissect a virtual frog and learn about its various body parts without cutting a real frog. Using web technology, students can publish their poems and stories and attract attention of the readers. DTP software helps students publish their own school magazine with text, graphics, and photos. Projects can be done in collaboration. The case study of Delhi Public School, East of Kailash, New Delhi, demonstrates how students from far off places could work together to complete a project using e-mail, video conferencing, and other technological tools. There are several websites which promote this kind of collaborative work (for example, <http://www.think.com> from Oracle Corporation).

##### Box 4.5

##### Google Earth: A new tool for learning

Google Earth is Google's new satellite imagery-based mapping product which combines 3D buildings and terrains with mapping capability. All this together with Google search gives a powerful tool for learning. One can easily have an aerial view of any road and building anywhere on the earth. It can even help you find locations and details of restaurants, hotels, shops, and video playbacks of driving directions in some cities. All these are possible from the comforts of the house or the classroom. Microsoft has also come up with a similar product called 'Virtual Earth.'

## 4.2.6 Appropriate Software?

According to Alliance for Childhood (<http://www.allianceforchildhood.net>), computers can be harmful to children causing physical, emotional, and intellectual damages. So, 'developmentally appropriate' software should be procured. Both computer and traditional learning tools should be used together. Children should be encouraged to interact with teachers and parents to clarify doubts related to the software. Working as a group provides better learning experience.

## 4.2.7 Indicators of Effectiveness of ICT in Education

How can the school management measure the effectiveness of the use of ICT in education? Some of the indicators that they can be used for this purpose are as follows:

- *Intuition/satisfaction of the instructor:* The teachers themselves can evaluate whether they liked the whole experience of using IT in their teaching in the classroom. Their sense of satisfaction can indicate if IT needs to be pursued for that subject at all or the method adopted needs to be modified.
- *Student evaluation:* If the use of computers can provide alternative methods of evaluation of students' performance, they contribute to the effectiveness of teaching/learning process.
- *Reduced attrition/failure:* Some schools have observed that access to computers has decreased student's absence from classes.
- *Increased grades and test scores:* The marked improvement in students' performance can also indicate effectiveness of IT in teaching.
- *Revelation and correction of misconceptions:* Use of computers is associated with a large number of myths with respect to their success and failures. If these misconceptions can be revealed and corrected, it will surely make the use of computers more effective.
- *Students 'turned on' to material not to technology:* The use of computers adds to the jazziness of a presentation, but if students like the content of those programs that do not have as much jazziness, it surely indicates appropriateness of the use of technology in learning.
- *Retention of fundamental/essential material:* If computers can be used to help students to understand and retain basics of any topic better it would be an achievement.
- *Increased opportunity for exchanging feedback between teachers and students:* The level of interaction between the students and teachers can be enhanced both qualitatively and quantitatively through the use of technology. If such a trend is noticed, one can be sure about the effectiveness of technology used.

Schools must look at these indicators to judge effectiveness of their ICT programs and take corrective actions, if required.



### 4.3 Assessment Using Technology

According to Thelwall (2000), computer based assessment (CBA) is an effective learning tool. In their study, students liked the test based on randomly generated objective type questions. In fact, they practised with mock tests, studied additional materials, and did well in the actual tests.

Technology can be used in the following ways to aid in assessment (Sheingold and Frederiksen 2000):

- Supporting student's work in extended, authentic learning activities: Simulation and video technologies help in this respect.
- Creating portable, accessible copies, and replayable performances: Students' drawing, musical performance, oral or written commentaries—all forms of data can be recorded, stored, and transferred to other places.
- Providing libraries of examples and interpretative tools: Scored performances can help assessor to evaluate better.
- Expanding the community of participants: Teachers can share assessment ideas with other teachers using technology. In a collaborative environment, peers can also assess each other's work.
- Publishing good work on the Net: It encourages research and acts as an incentive for good work.

The case study of Swastik School shows how technology is being used in student assessment. Mails are sent to students asking them to try specific tests for which they get the evaluation immediately. Software to evaluate essay type questions from the point of view of language, content, and structure, are also available. These make the task of teachers easy as otherwise a lot of time is spent on evaluation of student's work. Teachers can then review the evaluation done by the software.

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## CASE STUDY II

### Development of CAL Packages (Apeejay School, NOIDA)

#### Introduction

Apeejay School, NOIDA (ASN) is affiliated to the Central Board of Secondary Education, New Delhi. In a short span of 23 years, it has established itself as a reputed school in NOIDA. The school has classes from Nursery to XII. At +2 level, it has both science and



commerce streams. There are about 3,000 students, 300 teachers, and 55 non-teaching staff in the school.

### Information Technology Infrastructure

The school had five computer labs and one LCD room. Lab 1 had 22 Pentium-IV systems which was meant for pre-primary students (nursery to class I), Lab 2 and 3 had 25 Pentium-I machines each and they were for class II to V, Lab 4 had 25 Pentium-III systems which were for classes VI to IX while Lab 4 had 25 Pentium-III systems and it was for classes X, XI and XII. All five labs were connected through a campus wide network and there was a separate server room. There were computers in all science labs, staff and in-charge rooms, all activity rooms, library and administrative blocks. In all, the school had over 250 computers.

Almost all machines had net connectivity. Bandwidth was received from two sources: 128 kbps broadband link from Dishnet and 256 Kbps link through VSAT facility from HCL Comnet. In fact, it was planned that in future, all Apeejay Schools would be connected through VSAT facility.

All computer systems in the school were sourced from HP and IBM. The network was based on star-bus topology.<sup>1</sup> The school had one full time hardware engineer to maintain the systems, while the second one was shared with another Apeejay School.

The school had procured a number of multimedia CDs for pre-primary students. Besides standard packages like Windows, MS Office, and C++ compilers, etc., the school also had other software like Flash, CorelDraw, RoboForge, game making and, 3D Max and music making software.

The school had 12 computer teachers (two for pre-school, three for primary, two for seniors, three for middle school and two for CAL packages). There was a Database Administrator (DBA) who looked after school administration database and two data entry operators. The staff room had about 10 computers with Net connectivity. There was a scanner in Vice-Principal's office. Each teacher had a login and password for the network.

There was a computer club that organized quizzes and talks related to computers. Students also maintained an unofficial site of the school (<http://www.nvd.org>) which was linked with the official site at <http://www.apeejay.edu>. A robotics lab was being planned.

### Computer Aided Learning (CAL) Program

The school had a graded computer education program from nursery to class XII. Pedagogical tools like computer aided learning packages were extensively used to build and reinforce knowledge and skills among students. The school had almost 600 CAL packages on various

<sup>1</sup> In star topology there is a central server and all nodes are connected to the server directly giving an appearance of a star whereas in bus topology all the nodes and server are connected to a main trunk line. Star-bus topology is a combination of both star and bus topology.

subjects and for a various classes, developed by school teachers (see *Exhibit 1* for a number of packages for various subjects and classes). As ready made packages were inadequate to handle the requirements, Apeejay Schools (all five schools under the society) decided to develop their own. The curriculum was well designed with clear indication of which CAL package must be used for teaching a particular topic and this was categorically mentioned in the printed syllabus provided to students. At least every section got one class for CAL for each subject. In the time table, the CAL class was fixed. If there were any free slots, they were announced every week and a teacher could book it for taking extra classes.

Most of the CAL packages had self assessments to help students track how much they had learnt. If required, they could go back to the content at their own pace to learn the subject better. For some packages, students were given worksheets to work on at home as part of extended learning. However, most packages had graphics and animation but no voice. The idea was to have the teacher's voice during these demonstrations. In some, hyperlinks were given, but none of them were Net linked.

As part of the digital teaching and learning process, in each class a 29 inches TV attached to a computer had been installed. All the class room computers were connected to the campus wide network. Bharatiya Vidya computer-aided learning system had been procured from ZIL Industries and loaded in the main server. This helped the teacher explain certain components of a topic better. For example, it was difficult to illustrate how joints in the human body worked by drawing on the blackboard. But the animation provided by Bharatiya Vidya demonstrated this very well. Thus, this system complemented class room teaching. Bharatiya Vidya modules were generally used in secondary classes while primary classes depended upon the CAL packages developed by the school.

The computer literacy program (CLP) of the school aimed to provide basic knowledge about computers to the students. Teachers used the LCD room for presentations (CAL package, CD purchased from outside and materials downloaded from the Net) and clarify certain concepts. Thereafter, the students used CAL packages on their own in the multimedia lab to clarify their doubts and/or reinforce the concepts learnt. Sometimes, students were taken directly to the lab to work on CAL packages. The subject teacher used to explain the concepts presented in the package. Typically, 20 minutes were reserved for demonstration in LCD room while another 20 minutes were spent in the multimedia lab. Computer teachers maintained record of all CAL classes held. These were then analyzed for teacher dependence, ease of use, etc.

## Process of CAL Development

The program of developing CAL package started in 1996. The thrust was to introduce technology in teaching and learning. According to Mr Hasija, Principal, technology could not replace teachers, but its right use had two dimensions:

- Teachers using technology for teaching.
- Students using technology for strengthening the concepts learnt.



He believed that if concepts could be taught by other means, technology should not be used. It should never be used for technology's sake.

Apeejay Education Society (AES) developed the required CAL packages systematically. First, it formed a Supervisory Committee consisting of Mr Rajesh Hasija (Principal, Apeejay School, NOIDA), Mr B. S. Garg (Advisor-Education, AES), and Mr Amitabh Mishra (Head, IT, AES). In choosing the members it was decided that there should be a person from education (Mr Garg), one from technology (Mr Mishra), and one who understood both (Mr Hasija). That way, all the dimensions would be taken care of in the development of CAL and there would be synergy in the team. Initially, five CAL packages were developed by the software team of the Trust.

The Supervisory Committee then organized a training program for three days for teachers of all the Apeejay Schools (NOIDA, Saket, Sheikh-Sarai, Faridabad and Pitampura) and explained the objectives behind developing CAL packages. Teachers were also shown all five CAL packages so that they could develop an understanding about them. In that meeting, Course Committees consisting of subject teachers from each school were formed for developing more such packages which included two for science and social studies from each school while one from each school for other subjects. Each Committee was asked to select topics for which CAL packages were to be developed and divide the task of writing script among different schools. Regular meetings of these committees were organized and in each meeting of the Subject Committee, a computer teacher was present to clarify doubts regarding suitability of the topic and methodology from the point of technology.

Each course writer was given 30 to 40 days to write a script each of which was written by one or more teachers. One computer teacher of the school was designated as the CAL coordinator. CAL coordinators and principals of all schools used to meet frequently to analyze the current status of development and future course of action. They also decided on the kind of hardware to be procured by each school.

Once the scripts were ready, they were handed over to a software team consisting of six to seven experts hired by AES as regular employees of the Trust who converted those scripts into CAL packages. Normally a time period of one to four months was given to develop a package for which Visual Basic version 6 was used. As and when some packages were ready, the Subject Committee was asked to review it and give feedback.

## Testing of CAL Packages

Apeejay School, NOIDA was entrusted with the responsibility of compilation and coordination. It was also the first school to try out the new CAL package.

Changes were made in the CAL packages as per the feedback received from teachers. Once a package was received by Apeejay School, NOIDA, it was shown to all the teachers and each one was asked to give a written feedback. If the package was approved, it was put in the server, so that the teachers could use it and provide more feedback. Apeejay School,

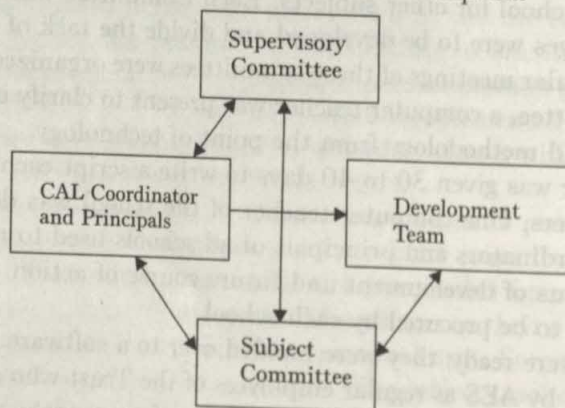
NOIDA carried out the quality check for all packages. First, it used the package and cleared it on the quality front. Then it was used by other schools. Feedback regarding the new package was received by the CAL Coordinator of the school and passed on to the development team in a compiled format.

The process of development and modification of the packages continued for three to four years. In 2003, no new CAL package was written. All the packages were copyrighted and they were not lent or sold to other schools. However, no package contained the name of the people involved in development, both at the script and production level.

Teachers identified closely with the packages since they were involved in their development. Each teacher was also paid for writing the scripts. Timetable and syllabus were modified to accommodate use of CAL packages.

The Computer department in the school not only helped in technology integration, but also in clarification of the concepts. When students went through CAL packages, both the subject and computer teachers were always present.

**Figure 1**  
Organizational structure for CAL development



## Experiences in the Process of Developing CAL

When teachers were initially introduced to CAL, there was a lot of hesitation regarding their ability to write scripts. Many of them did not have any knowledge about computers. Thus, initial packages were of low quality, but as teachers gained competency in technology and understanding regarding CAL, they were able to write and thus develop better CAL scripts and packages.

While developing CAL packages, there were many interesting experiences. For example, one teacher did not like what was produced and went about rewriting the entire script. Also, many of them found that the software experts had misinterpreted their scripts and copied down the instructions meant for software experts as part of the package. There were



also other errors, such as, a script writer wanted four pictures in four screens, while the programmers put them all in one. In order to avoid such mistakes, color codes were introduced. For example, any text written in red was for the programmers while those in black was to be reproduced in the package. This facilitated the communication between script writers and developers. Most pictures given in the CAL packages were provided by the teachers which were scanned and then put in the appropriate places.

## Training of Teachers

The school organized a number of workshops on IT (Windows, Word, and Excel) for teachers. In 2001, a large number of teachers attended the Intel certified training programs. There were three Intel Master Trainers among the teachers of Apeejay School, NOIDA. By 2003, all teachers were computer literate. Besides being trained on the technology, they were also sensitized about the role of technology in education.

## Observations of Teachers and Students Regarding Use of CAL

*Madhuri Saxena, Head, Computer Department*

Ms Saxena has been working in the school for the last seven years. According to her, certain concepts like environment, people from different countries could not be explained well using the conventional method of teaching. The use of CAL packages helped explaining abstract concepts better, using pictures, and animation. Children also loved to learn at their own pace which was made possible in the case of CAL packages. As most of the American packages were not suitable for Indian situations, the school decided to develop its own.

*Mini Chopra, Primary Teacher, Science*

Ms Chopra found CAL packages useful since they provided information beyond the text book. Because of interesting pictures and animation, it held the interest of the students. She also mentioned that there was a lot of debate regarding the need to have packages with audio. But finally, it was resolved that it would be better for the teachers to add their verbal explanations while demonstrating them. As the teachers were adequately trained, they did not find it difficult to write the script. She found students quite involved while working on CAL exercises.

*Vaibhav Batla (Class V-A) and Paroma Varma (Class V-D)*

Both of them liked the packages in social studies. They found that it had information not given by the teachers in class. They also liked the fact that all the assessments did not have scoring. At any point in time, one could go back to the text using 'Previous' button and find the right answer. They found it fun to work on computers.

**Exhibit-1**  
**CAL Packages**

| Class    | EVS | English | GK | Maths | Social Studies | Science | Total |
|----------|-----|---------|----|-------|----------------|---------|-------|
| KG       | 14  | 7       | 4  | 4     | -              | -       | 29    |
| NM       | 2   | -       | -  | 10    | -              | 3       | 15    |
| I        | 37  | 16      | -  | 14    | -              | -       | 67    |
| II       | 16  | 4       | -  | 13    | -              | -       | 33    |
| III      | 1   | 5       | -  | 9     | 15             | 22      | 52    |
| IV       | 1   | 11      | -  | 21    | 21             | 15      | 69    |
| V        | -   | 7       | -  | 25    | 16             | 9       | 57    |
| VI       | 1   | 3       | -  | 4     | 9              | 22      | 39    |
| VII      | -   | 3       | -  | 14    | 7              | 26      | 50    |
| VIII     | -   | 3       | 3  | 11    | 9              | 32      | 58    |
| IX       | -   | 1       | -  | 10    | 15             | 16      | 42    |
| X        | -   | -       | -  | 3     | 3              | 9       | 15    |
| XI       | -   | -       | -  | -     | -              | -       | -     |
| XII      | -   | -       | -  | -     | -              | 2       | 2     |
| I-II     | -   | 1       | -  | -     | -              | -       | 1     |
| I-V      | -   | 4       | -  | -     | -              | -       | 4     |
| II-III   | -   | -       | -  | -     | -              | 1       | 1     |
| II-IV    | -   | -       | -  | 1     | -              | -       | 1     |
| II-V     | -   | 1       | -  | 1     | -              | -       | 2     |
| III-V    | -   | 4       | -  | 1     | -              | -       | 5     |
| III-VI   | -   | -       | -  | -     | -              | 1       | 1     |
| III-VII  | -   | 1       | -  | -     | -              | -       | 1     |
| IV-V     | -   | -       | -  | 3     | -              | 1       | 4     |
| V-X      | -   | -       | -  | 1     | -              | -       | 1     |
| VI-X     | -   | 4       | -  | -     | 3              | 2       | 9     |
| VI-XII   | -   | 1       | -  | -     | 1              | -       | 2     |
| VII-VIII | -   | -       | -  | -     | 1              | -       | 1     |
| VII-X    | -   | -       | -  | -     | -              | 1       | 1     |
| VIII-IX  | -   | -       | -  | -     | 1              | 2       | 3     |
| VIII-X   | -   | 1       | -  | -     | 2              | 2       | 5     |
| IX-X     | -   | 4       | -  | 1     | -              | -       | 5     |



Teachers are the backbone of every educational institution. For the effective deployment of ICT in schools, teachers have to play a pivotal role. In fact, only if teachers have a positive impression about the technology and are involved in its deployment, IT can be effectively used in schools (Rudduck 1991). It has been found that even Information and Communication Technologies (ICT) designed to facilitate self-directed learning works well only when teachers play an important role in facilitating learning (Papert 1980).

Thus, the first and foremost concern of the school administration would be to find ways of making IT acceptable and beneficial to teachers. This section examines the different aspects of the relationship between the teachers and IT, and suggests ways of involving all the teachers in the use of IT for better teaching and learning.

In any school there are two categories of teachers: IT/Computer teachers and non-IT or subject teachers. As the issues and requirement for these two groups differ, they are treated separately in this chapter. For the former, the most important concern is the shortage of teachers and training the existing computer teachers in teaching-learning methods. For the latter, the issue is to motivate and train them to use technology and change attitudes.

## 5.1 Computer Teachers

Under contract with private providers, computer teachers are recruited from non-formal computer training institutions (such as NIIT or Aptech) and so they are never considered as part of the schools' teaching fraternity. However, when the initial contracts expire and schools adopt their own computer education programs, some of the teachers supplied by the IT companies are retained and are slowly mainstreamed with the other teaching staff. However, they remain unique on two fronts. First, the task of the computer teachers is unique as they not only teach their own subject, but also participate in software development in the school and extend help to other teachers in their quest to integrate IT in their teaching. Second, several of these teachers do not have formal training in teaching-learning methodologies.

In addition, schools find it difficult to hire adequate numbers of experienced and quality computer teachers. This is a universal phenomenon and it is due to high paying jobs in the field of IT. However, this problem can be overcome by adapting some of the suggestions given below:

- While recruiting computer faculty, principals may stress on the teacher's attitude and their ability to learn, rather than their qualifications per se. IT is a fast changing field and computer teachers need to be in constant touch with it and thus the ability to learn and openness to new ideas and skills are vital.
- Sometimes, it makes better sense to hire a good science graduate with interest in computers and train him/her to teach computer science than to hire a below-average MCA/computer science graduate. In fact, existing science teachers can be trained and encouraged to shift to computer science.
- Schools may also experiment by using interested senior students to act as lab guides for their juniors. Even in the same class, some experienced students may be asked to help their cohorts. This arrangement can provide recognition for some students while making it easy for others to learn from their batchmates and overcome the shortage of trained computer teachers.

Educational computing has been largely driven by technology rather than curriculum (Bromley 1994). Most schools waive the requirement of Bachelor in Education (B.Ed.) qualification for computer teachers to overcome the difficulty of finding people with both IT skills and B.Ed. qualification. To overcome the lack of formal training in teaching methods, schools must provide appropriate training in teaching-learning to computer teachers (Davis 1997). This is not as easy as it sounds because many computer teachers are more often interested in learning the latest computer technology (which may not have much to do with the school syllabus), rather than acquiring teaching-learning methods. Thus, the principal has to find ways to motivate computer teachers to invest in acquiring teaching skills (some of the suggestions given later in the chapter on motivating teachers to adopt technology will also be useful here). Trained IT teachers can also help subject teachers to use IT in their classrooms. The concept of team teaching can thus be encouraged.

## 5.2 Subject Teachers

The daily routine of subject teachers was more or less monotonous and comfortable until IT hit them in a big way. With the introduction of IT, they not only had to continue to master their own subjects, but also had to learn how to use IT in their teaching. The next few paragraphs highlight the benefits of IT for teachers, depict the challenges that they face, skills they need to pick up, and the training process that can be useful for them.

### 5.2.1 Understanding the Needs for Teacher Development

A study by Harold Wenglinisky for New Jersey-based Educational Testing Services showed that teachers who had prior training in computers were more effective in teaching IT than



those who did not have any training at all (Archer 2000). To develop the required competencies in teachers, a principal has several options—organize appropriate training programs highlighting the use of technology; sending teachers to attend relevant programs conducted by outside agencies; use Internet for training teachers.

To be able to make appropriate training decisions for his/her teachers, a principal needs to understand the needs and requirements and also the pros and cons of the types of training modes available.

Any teacher using IT in his or her teaching for the first time would go through the following steps (Davis 1997):

- Competence with software.
- Understand the place of that software within the curriculum.
- Start using the software for the benefit of students.
- Enlarge the range of practice and usage.
- Enhance learning through IT.
- Improve practices in courses, classrooms and assessments.

According to Mrs Meera Balchandran, Principal, Ramjas School, New Delhi, adoption of technology by teachers goes through the following five stages:

#### (Stage 1) Entry

- Teachers are not technology users.
- Students use technology as determined by someone else.

#### (Stage 2) Adoption

- Teachers use technology to support traditional learning.
- They use new tools to perform traditional tasks (for example, the teacher may use the word processor instead of a typewriter to prepare a newsletter).
- Limited use of technology.

#### (Stage 3) Adaptation

- Technology is now used to enrich the curriculum.
- The teacher may use material from a Website to enhance his/her lesson.
- CD-ROM encyclopedias may be used to support teaching.
- Student enquiry may be directed by the teacher.

#### (Stage 4) Appropriation

- Technology is used for its unique capabilities. It is integrated.
- Technology is viewed as a tool for learning and teaching.

- They design experiences to take advantage of IT.
- It is used to achieve desired outcomes.
- Projects assigned would attain a personal approach as the student is empowered to use the tools of his/her choice.
- Students may also use presentation tools.

#### (Stage 5) Invention

- New uses for technology are discovered.
- Tasks requiring higher order thinking skills that leverage the power of technology are designed.
- Learning is woven around a series of skills like creating a web site.
- Technology is considered as a valuable tool for collaboration, innovation and creativity.

### 5.2.2 Benefits of IT for Teachers

There are several benefits of IT for teachers (Karsenti 2002):

- *Elimination of physical limits imposed by classrooms:* Teachers can connect students to resources available in different parts of the world who in turn, can work with peers from other schools.
- *Greater access to information and knowledge:* Information on any topic is now just a mouse-click away.
- *Increased motivation to learn for future teachers:* The concept of life long learning and self-learning is becoming easier and possible.
- *More effective and custom made teaching:* With the use of presentation software, teachers can modify their material even in the last minute and customize it for the intended audience. It can provide more control over what to present and when. Multimedia-based presentations are preferred by students.
- *More efficient teaching management:* IT helps in evaluation and other administrative activities.
- *Improved and more frequent communication among educators and students:* E-mail, online chat, and video conferencing make frequent communication possible.
- *Enhanced critical thinking:* Instead of stressing on collecting information, analysis of information that enriches critical thinking ability can be emphasized.
- *Greater autonomy for future teachers:* Using computers, teachers can have greater control over their resources, student data, and less dependence on supporting staff members.

A principal needs to first develop an understanding of the benefits and then create a culture where teachers not only appreciate the benefits but are also enthusiastic about adopting them.



### 5.2.3 Challenges/Problems Faced by Teachers

In addition to understanding the benefits, a principal must also be aware of the challenges that a teacher faces in adopting IT. Because of these challenges most teachers resist from embracing technology. Teachers face several hurdles in using technology while teaching (Bobowick 2001, Friedman 2002). These are:

(a) *Learning new things*

- Teachers need to expand their knowledge about the subjects, they teach, as students are likely to have access to more information because of the Internet.
- Teachers need to learn new pedagogies like discovery learning and communities of collaborative learners to make better use of IT in teaching.

(b) *Change in status*

- The type of instructions associated with technology shifts the focus from teachers to students. This can be unsettling for teachers.
- The difference of knowledge level in technology between students and teachers is often negligible. In fact, often teachers have to depend on students to learn new skills.

(c) *Anxieties*

- Teachers have to spend enormous amount of time in learning how to operate a new piece of software. This may cause 'techno-anxiety.'
- They need to start appreciating the culture and ethos of 'wired society.' Otherwise, they may find it difficult to operate in the cyber world.

(d) *Ambiguities*

- With several experiments in progress and no clear identification of best practices, teachers are at a loss regarding what to use and when.

(e) *Information Overload*

- Information overload is another problem for teachers. This happens when there is too much of information which confuses the user and deters him/her from taking correct decisions (Herbig and Kramer 1994).

(f) *Time Management*

- It is normally believed that the use of ICT can reduce the time needed for teachers to be present in person. Hence, teachers will have more time if they adopt ICT. But in reality the situation is opposite. It takes enormous time to look for resources and prepare ICT-based lessons. Thus, both teachers and school management must understand the amount of time spent (Dawes 1999).

## 5.2.4 Motivating Teachers to Use Technology

Motivating teachers to use technology is one of the major challenges for principals to ensure effective implementation of IT in schools. Motivation towards learning a topic can be enhanced if it attracts *attention* (A), if it is *relevant* (R) to the person, if the person is *confident* (C) about mastering the topic, or if it is *satisfying* (S) to the person (Keller 1983). In addition to designing instructional material, this theory has also been used to personalize training. It has also been proposed that there are individual differences in motivators and while one teacher might be motivated by something that attracts attention, another might be motivated if the topic is satisfying (Surrey and Land 2000). Thus specific strategies for motivating teachers to use technology can be designed depending on what specifically motivates them. For example, to attract attention towards a topic that is taught, practical use of technology must be showcased. People who are motivated by *relevance* believe that a lot of time is required to be able to use technology. For such people, it needs to be shown that the benefits accrued is worth the time spent. Technology can help in retention of understanding and making better decisions. To teachers looking for *confidence building*, efforts should be made to provide opportunities to master various types of technology. Those wanting *satisfaction* from the topic may look for both intrinsic and extrinsic benefits in using technology. There should be some reward for the use of technology and teachers should be helped to realize that effectiveness in teaching and research can be enhanced by using technology.

Technology available to the principal can also be used for motivating teachers. Online mentoring, motivational speeches on the web, and public recognition of teachers on school Website might be used.

Thus, principals have to devise specific and varied strategies to motivate teachers to use technology.

## 5.2.5 Desired Competencies and Skills for Teachers Adopting ICT

To handle the challenges that have been iterated, teachers need to develop certain competencies (Holvig and Crisci 2001):

- *A level of comfort with technology.* Fear of technology can hamper any learning process.
- *Willingness to learn with students.* Changing the role from being a giver of knowledge to that of a facilitator.
- *Flexibility with time and scheduling.* Allocating extra time to explore the Internet and other sources.



- *Willingness to accept self directed learning.* Recognizing that in IT much can be learnt by trial and error.

Teachers should not only be trained in the use of hardware and software, but also on how to use technology in teaching and learning processes (Siegel 1994). Pelgrum (2001) prescribes the following technology skills for teachers:

- *Didactic and organizational integration of computers in subjects.* ICT should be seamless in its use in other subjects to ensure that the focus is on the subject and not on IT.
- *The use of specific programs for subjects.* Develop skills to identify the relevant programs for use in teaching.
- *The use of multimedia applications.*
- *Use of school automation software.* This helps in keeping record of students' performance and other details.
- *Adaptation of software to fit own purposes.*
- *Evaluation and selection of instructional software.*
- *Use of computers for individualized learning programs.* Identification of software which students can use to enhance their learning.

So far, most of the ICT initiatives in schools have focused on students and neglected teachers (Dawes 1999). A principal of a school needs to be aware of the skills needed, requirements of the teachers, and anxieties raised by the challenges posed by new technologies. Based on their awareness and understanding, a principal needs to take charge of equipping the teachers for embracing and exploiting technology for teaching.

## 5.2.6 Training Subject Teachers to Use ICT

November (2001) argues that teachers' training should focus not on technology, but on how students learn with technology. He suggested student centered workshops, where teachers are made to observe how students in groups learn using technology. According to him, the workshop can have the following four phases:

- Learn how students learn. Observe how students are using technology.
- Engage with students (not only observe, but have a dialogue with students to know why they do what they do).
- Reflective collegiality where teachers discuss their insights with each other (students are not present).
- Continued dialogue between teachers and students.

### 5.2.6.1 Using Net-Based Training

It has been found that Net based teacher training programs are more effective when compared to the conventional method. This can help teachers to opt for on-line courses (known as e-training) and certification and benefit professionally in the long run.

The advantages of Net-based training are as follows (adapted from Kante 2002):

- Allows anytime and any place learning.
- Provides access to a number of learning resources.
- Provides access to experts located all over the world.
- Offers opportunities to collaborate with other teachers to share ideas, lessons, and other materials.
- Can be tailored to specific needs of the trainee.
- Promotes self-directed learning.
- May be more cost-effective as use increases.

Many organizations provide e-training. One of them is World Links (<http://www.world-links.org>), promoted by World Bank, that offers e-training program focusing on the use of technology in teaching and learning.

Teachers as learners can benefit from online mentorship and peer collaboration. They can join several communities of practice: with colleagues in own schools, teachers of other schools, ICT users, etc. (Dawes 1999). According to Pearson (1999), electronic networking between teachers helps them share ideas on teaching and encourages reflective practice.

### 5.2.7 Supporting Teachers to Use Technology

Initial training though necessary, is not sufficient to get teachers to use technology on a continuous basis. Teachers must have access to trouble shooting help when they start using technology. Computer teachers are often not in a position to extend such support which can be provided by hiring a computer expert on a full-time or part time-basis. Networking with neighbourhood schools and industries can also be helpful. Another option is to hire an instructional technology consultant, who has both the requisite knowledge in technology issues and teaching skills. He/she can both trouble shoot hardware and software problems faced by other subject teachers and also team-teach with subject teachers. He/she may also help in enhancing effective learning of courses in information technology. Selected schools in Australia and United States have hired instructional technology consultants to help their subject teachers. Indian schools can also experiment with this concept.



### Box 5.1

#### Factors hindering motivation to develop oneself

- Dearth of mechanisms an individual teacher can use to diagnose learning needs
- Teachers find it difficult to set aside time for their professional development
- Past negative experiences with leadership or school
- Equating experience with competence
- Fear of being exposed
- Satisfaction with past learning
- Expressing a need for training may be construed as an acknowledgement of presence of certain deficiencies

*Reference:* A study by Vijay Shery Chand, IIM, Ahmedabad.

The process of staff development should encourage them to continuously keep pace with developments in the teaching-learning processes and how technology can make a difference. The concept of life long learning should be promoted. Principals should also show zeal in learning technology if he/she wants staff members to take to technology enthusiastically.

## 5.3 Action Research by Teachers

Another way in which teachers might be introduced and motivated to use technology in the classrooms is by using action research. This is investigation of one's own practice in order to improve it (Somekh 1997). Both action and research are carried out in a cyclical process which involves collecting data, analyzing it to formulate a plan of action, carrying out that plan of action, and then continuing the cycle. Spitz and Klais (2001) suggest that teachers should use it to find new ways of using technology as a pedagogical tool. For example, the teacher can use action research to make teaching with technology effective by asking and answering the following questions:

- What are the desired outcomes?
- What result should teachers expect from the students?
- How does technology fit into their teaching goals?
- What possible technology applications can bring in desired outcomes?
- Are the required resources and capabilities available? If not, then attempts must be made to acquire what is required.
- How to measure success?
- What indicators for success should be used?

This also adds to the knowledge base regarding best practices in teaching. Action research helps the teacher to interact with new situations, learn from them, and taking better decisions

in future (Kallick and Wilson III 2001). Computer teachers may also be encouraged to adopt action research to improve their classroom delivery and strategies that may work with different technologies.

The principals needs to create an environment for enabling teachers to embrace technology for improving teaching-learning methods and also to handle minor issues that can deter the teaching-learning process.

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## CASE STUDY III

### Teachers Training Program (Ramjas School, R. K. Puram, New Delhi)

#### Introduction

Ramjas School, R. K. Puram, New Delhi, was established by Ramjas Foundation in 1974. Established in 1912, it was one of the oldest foundations in Northern India. This School was among several public schools set up by the Foundation and has classes from nursery to class XII. In 2003, there were 1,900 students and 64 teachers.

Ramjas introduced computer education in 1986-87, the first school in India to do so. It was also the first school in Delhi to present its annual report using PowerPoint presentation during school annual day celebration. As the principal read the annual report, supporting photographs and materials were shown through computer presentation and LCD projector.

#### General Infrastructure

The school is located in an area of 5 acres and has aesthetically designed nursery classes, modern laboratories, specially designed activity rooms, and extensive playgrounds. The school has a medical center to provide first aid medical assistance to children and staff.

The school also has a Teachers' Center which is perhaps the first of its kind in India. It organizes various training programs for both in-house and outside teachers free of cost except when the school is required to pay some remuneration to the outside resource persons.

#### Computer Infrastructure

The school has two labs: Lab 1 has 22 Celeron and Pentium-III networked computers and similarly Lab 2 has 10 Celeron and Pentium-III networked computers. There is an Intel lab which is totally funded by Intel Inc. In fact it is the first lab set up by Intel in any school in India. There are a total of 16 Pentium-IV computers in the lab which is exclusively

used for project work both by teachers and students. Besides, there are six computers with Net facility in the library. Biotech and Biology Lab have one computer each while the reading room for junior students has one computer. There are separate networks in each lab, and all the computers in the school are not connected through one network. This is to be done once the school installs school management software. The Net connectivity is through dial-up connection from MTNL.

There is an audio-visual (AV) room and according to the time table prepared by the school every class has a designated AV period. The AV room can be booked by the teacher when it is not in use. The school has procured some CDs from SchoolNet.

There are five computer teachers. The school has outsourced the computers of the lab as well as the computer teachers. Mr Umakant Pandey, the School Coordinator who is trained at NIIT, help the principal in planning various training programs for teachers. He also extends the required technical help to the teachers in Intel Lab.

### Use of WebQuest

Mrs Meera Balchandran, the principal, has been able to promote an interesting pedagogical tool called WebQuest to teach english, history or any other subject. WebQuest includes a sample presentation with brief guidelines, some links, and the task. The participants are required to look into the links and make their own presentation using the materials given in those links using MS Publisher (PowerPoint could be used to make the presentations). Meera has conducted several training programs for teachers from other schools using this methodology and has found the tool quite effective. School teachers are also being trained to use this pedagogical tool.

Since last two years, the school has been organizing an inter-school contest called 'Dynamics.' In 2003, about 15 schools of Delhi participated in this contest which involved events like advertisement-making for seniors and planning an art gallery for juniors, using the WebQuest method. Students were given downloaded materials on a topic and then asked to make the presentation, for which they had to write the text in their own language but could use the pictures verbatim.

### Training Program for Teachers

The training program for teachers on technology started in March 2000 with Intel's 'Teach to the Future' program. While primary teachers have been trained by SchoolNet, middle and senior level teachers have gone through Intel's program. Both the training programs have been for 10 days. Subsequent to initial programs, further training input for teachers are designed by SchoolNet and they also provide teaching/learning CDs. Every week, one expert from SchoolNet visits the school to help teachers in learning or preparing technology-based



lessons. As SchoolNet employs former teachers and provides them enough technical training, their experts understand both teaching and technology.

Intel has been promoting technology in education in USA for quite sometime. When they initiated the same effort in India, Ramjas School was one of the first schools selected for the technology training program. Intel provided two kinds of programs: basic and master training. A teacher who had gone through the former could opt for the latter and after completing it successfully could become a master trainer, who could then train other teachers for the basic level program.

Older teachers were initially skeptical when training programs were introduced. But gradually teachers got used to technology. By 2003, all of them made their presentation using PowerPoint for the annual faculty council meeting in the school.

The initial training programs have been followed by regular training organized by the school to keep its teachers updated with technology. Every year, six days of computer training is organized for every teacher. This is split into three programs of two days during the terminal examination, during which time, teachers are relatively free.

Every week, each teacher has two periods of computer access. For example, all Hindi teachers work in the Intel lab on their lessons or to learn new skills on fifth and sixth periods of Mondays. Mr Pandey is available in the lab to help the teachers. Each teacher is expected to prepare at least one computer assisted lesson in a year.

In April 2000, the school introduced the use of CAL packages (english, mathematics, science, and social studies) in primary school. For middle school, only one subject in a class is taken for computer aided learning. For example, in class VII science can be taught using CAL, while it can be english for Class VIII. The school decided that all teachers whether teaching a class or not would participate in preparation of CAL and while preparing the lesson the following factors should be kept in mind:

- Time taken to complete the lesson
- Student performance at various levels: bright, average, below average
- Student involvement
- Student-teacher interaction
- Joy of learning

In senior classes it is left to the teachers to use CAL wherever they feel suitable to do so. Students of class X are involved in preparing lessons for junior classes.

### **Other Support Mechanisms**

Each subject has an audio-visual period per week. Primary class students have four CAL classes in a week. A compiled list of CDs procured from the market have been prepared and put up in the computer lab for the benefit of the students and teachers.

## Principal's Own Conversion to Technology

Mrs Meera Balchandran has been principal of the school since 1974 and the school has been offering computer courses since 1987. But till 2000, she did not take much interest in technology. The service provider totally looked after computer education in the school. All this changed in 2000. She was invited along with the principals of some other schools of Delhi by Intel for a breakfast meeting where the expert from Intel enumerated about the use of technology in education. Later, the Intel expert visited Ramjas School and offered to set up the first Intel lab in the school. She not only offered 16 computers, but also promised to train all the teachers. With this, the training of teachers at Ramjas School started. Witnessing the teachers being trained Meera also got interested in technology and she joined the last batch of training. Later she did three week long master training and became a master trainer.

By 2003 Meera had trained more than 100 teachers on behalf of Intel. She had also attended the SchoolNet training program and was also among the few to attend Intel's program 'Seeing Reasons,' where one observes how students make decisions to be able to customize teaching. She also developed manuals on:

- Integration of technology
- Using technology effectively for teaching English at the primary level
- Using Net

According to Meera, greater involvement of principal can only help in making effective use of technology. Thus, principals should not be isolated from using technology in schools. According to her, the minimum computing skills that a teacher must have are—how to use Internet and how to prepare documents, electronic worksheet, and presentation. The trainer should be gentle with the first time learners of the technology.

Apart from generally motivating, she has arranged for loans from Syndicate Bank for teachers to buy computers. Many teachers have availed this facility. She has also installed six computers in the library with Net facility so that both the students and teachers can use them to collect information from the Internet.

## What Teachers Say?

It is observed that teachers have a high level of confidence in using technology in teaching at Ramjas School. Some of the observations made by some of the teachers are illustrative.

*Bhubaneswari Dixit, Sanskrit Teacher*

She has learnt a little about using computer from home by observing her children. She joined the first batch of Intel training program where she learnt how to make lessons using PowerPoint for Hindi language training. She used Susi Hindi fonts and her first lesson was on



the topic 'Badan' in Hindi Grammar. She used a lot of clipart to prepare her lessons and was especially proud of a lesson she prepared on 'write a short essay by looking at the picture' for Sanskrit classes. There she put a picture and a few Sanskrit words on the computer screen and asked the students to write a few sentences about the picture using the given words. This exercise helped increase the word power of the students. Using computer, she has been able to show different pictures which caught the attention of the students. Except the problem of Susi program changing the script back into English alphabets, she has not encountered any problem in using computers. Mrs Dixit has already undergone three training programs.

She would like to learn animation to enable her to prepare more interesting lessons and would also like to pick up more pictures from the net. However, she felt that the keyboard was not very suitable for the Hindi script.

#### *Ritu Raha, Social Studies Teacher*

Ritu Raha has been working in the school since 1989. Her first introduction to computers was through the Intel training program organized in the school which initially worried her since it was supposed to be from 9 A.M. to 4 P.M. and she was not prepared for such long hours. In fact, for the first two days, she found the days long, but later she stayed beyond 4 P.M. and still did not feel bored or tired. The training programs of the school have given her adequate knowledge about computers. There has been a lot of peer learning during the access periods when all social studies teachers came to the lab for two periods to work on their own computers. This also ensured that there was no repetition of efforts and all the subject teachers got opportunities to discuss certain issues and concepts. She was inspired to learn more when she found students do well on computer assisted assignments. She sometimes found it difficult to cope up with the skill levels shown by her students.

She had some good opportunities to interact with teachers from other schools during Intel training programs. She was in touch with a social studies teacher in USA but found that because of difference in the system of education, she was not able to follow their model of teaching. She also employed other methods like reading books and talking to friends to enhance her knowledge about the technology. She visited several monuments of Delhi and took their photos. Then she prepared a lesson using those photos and this turned out to be a very interesting class for the students as they were able to relate to those pictures and learn better about history.

Ritu knows MS Office, animation, use of Net and Excel adequately well. Over the last few years she has been able to learn new skills and modify her lessons.

#### *Swati Parulkar, Science and Mathematics Teacher*

Swati has been working in Ramjas School since 1994. In her earlier job, she had learnt Wordstar and some other packages. She had a computer at home and learnt about it from her husband. During Intel training program at school she learnt how to make PowerPoint

presentation and prepare mark sheets using Excel. In Teachers Center she viewed CDs procured by the school. She herself made a few lessons but mostly used the CDs purchased from the market. She used a lot of e-worksheets. One of them was a PowerPoint/Word slide/page having crosswords and puzzles. Students liked these e-sheets as they found both text and pictures. She also found it easy to prepare new e-sheets by changing certain existing components and adding new components. Students' interest had been her motivating factor to work with technology. She hopes that if the school can provide more computers, she can organize online assessment.

According to Swati, technology should be learnt and exploited. Principals should ensure that teachers made better use of technology. In her own school, making it's use compulsory proved useful. Use of technology has made teaching easier and interesting. Swati has been able to get more information from the Internet and present it to her students.

*Vandana Choudhary, Geography Teacher*

In 2003, Vandana helped carry out a project titled 'Census in the Class' as part of the assignment in Geography class. Students were asked to collect data from their friends, analyze, and present them in a useful manner. They were given two weeks to complete the task. Many students simply sacrificed their games' periods and worked on the project. Students used Excel to analyze data and create various graphs. According to her, this helped in data interpretation capability of students. The use of graphics helped in better retention of the concept. Though activity based work has been followed in the school for long, the use of computers has made the task more interesting and it also saved time spent on preparing the activities. In addition, it also helped in saving money.

Vandana picked up computer skills through the training programs conducted in school. As help was always available in the Intel lab, she could overcome trouble while picking up computer skills much earlier. According to her, one must be open to learn technology, even from students. This would remove the fear of the technology. One must be judicious in selecting the pedagogical tool for a particular topic. Some topics in the course can be taught very well using computers. She does not mind using students as resources for some computer related work.

*Umakant Pandey, IT Coordinator*

According to Mr Pandey, the training programs have been able to transform the teachers to technology users. Otherwise, teachers used to keep away from computers. Even now there are a few who are not very comfortable with technology. He felt that if a teacher persisted for some time, then he/she can become comfortable with technology. There has been both peer pressure and motivation when some teachers saw others making a large number of lessons.



## Management

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While buying hardware or software, installing them or later using the infrastructure to support various processes at schools, there are several management related issues that school administration needs to resolve. This section addresses some of these issues and choices.

### 6.1 Hardware Distribution

How should hardware be distributed in the school among labs and classrooms depends on the teaching and learning processes adopted in the school. It is ideal to have a computer in each class room for teachers to show presentations or Net resources and then have labs distributed throughout the school so that students can use them for working on their projects or revising lessons. Classrooms can also have several computers for students to do a quick assignment even during class hours. However, the more distributed the computers are the more difficult it becomes to maintain them. Keeping the intended usage and maintenance aspect in mind, decisions must be made on where to place the hardware. Many schools keep a number of computers in the library so that they can be used for Net access and project work.

#### 6.1.1 How Many Labs?

Normally most schools have two labs, one each for junior and senior students. Some have an additional lab for middle level students also. This division of computer labs has several benefits. First, the labs can be ergonomically designed/tailored to suit the students using it. Junior students can have smaller chairs, more colorful furniture, etc. Second, appropriate software can also be loaded on the server. Third, appropriate CDs can be made available in the specific laboratory. Schools may also plan to have more than three labs to provide greater access to students of a certain age group.

One decision which principals have to take is how to arrange the tables in the computer lab. There are typically three types of arrangement:

*Wall facing:* One common practice is to keep the tables against the walls on three or four sides of the lab and have a lot of space in the middle to enable free movement of students and teachers.

### Box 6.1 Ergonomics

Correct furniture and lighting are as important as having the right equipments. This aspect is called ergonomics. The height of chairs and tables should be as per the standard height of students. For example, recommended table and chair heights are:

| <i>Type of school</i> | <i>Age range</i> | <i>Chair height (mm)</i> | <i>Table height (mm)</i> |
|-----------------------|------------------|--------------------------|--------------------------|
| Nursery               | 3-5 years        | 270                      | 460                      |
| Infant                | 5-8 years        | 320                      | 540                      |
| Junior                | 8-11 years       | 370                      | 610                      |
| Secondary             | 11-15 years      | 370                      | 610                      |
| Secondary             | 15-17 years      | 420                      | 680                      |
| Secondary             | 17-adult         | 450                      | 730                      |

Lighting should be such that it does not fall directly on the computer screen. Electrical wires should be kept out of the way and keyboards should be comfortably placed. Several health-related issues may crop up if ergonomics is ignored.

*Note:* Recommended heights for chair and table are taken from NGFL's (National Grid for Learning) document 'Points to Consider when Planning a Computer Room.' More such detailed information about designing computer infrastructure is available at <http://www.ict.oxon-lea.gov.uk> site.

*Front facing:* The second alternative is to have the computer tables across the width of the room with two tables facing each other. This arrangement may accommodate more students, but can create complications for electrical wires placed across the room.

*Cluster:* The third alternative is to have several round tables in the room with two to three computers on each table. This arrangement may promote group work.

The arrangement of tables should be made depending on the shape and size of the room, light conditions, space required for free movement, and intended use.

## 6.1.2 Open Access Area

Some students may need to use computers during their free periods for working on projects. So as to not disturb those students who are working in the labs as per their schedule, schools may be well advised to design one open access area or lab. This could be the place where students can work any time. Some schools have computers in the library or in a separate resource room for this purpose.

In a library, computers can be a part of the reference section. There should be a CD library close by and computers should have Net access. The students can use these computers to get the information they want. This then becomes a digital library. The school can also download information on various topics and put it in the school server so that students can directly use them instead of downloading the same individually from the Net.



Some school principals feel that having the computers in the library may hamper the normal library period in the school. It however depends on the size of the library. If it is large enough, a separate space (may be with glass partition) can be created for the digital library facility. Otherwise, schools can have a separate project room having computers with Net and other facilities. Of course there has to be a technical person to help and to oversee students working there.

### 6.1.3 Specialized Labs

Some schools have set up computer equipped special labs. For example, Hansraj Model School in Delhi has set up a mathematics lab equipped with software like Mathematica. Though it provides many features that school students hardly use, still students enjoy seeing graphs of mathematical functions and solving complex equations in mathematics. In fact, schools can set up CAD lab wherever they have engineering drawing as a course in class XII. Language learning labs can also be designed for teaching several languages and improving communication skills in english. Computers can be a biggest aid in language teaching as students can speak and the same can be recorded and played back very easily. This can also be compared with the speech stored in the computer.

### 6.1.4 Computers on Wheels

Computers on Wheels (COWs) are carts that hold a set of computers.(usually laptops), an LCD projector, and may be a printer, that can be taken from one classroom to another and used for some specific activities. In this case, the school does not need to install computers in every classroom. A few sets of COWs can be used by teachers when they need to. If the school makes use of WiFi or cableless network, these computers can also be made part of the Network, and can have Internet access. However, COWs need careful handling as they would be constantly moved from one place to another. Also the choice of hardware for COWs needs to be rugged and sturdy. Another problem with the COW is that if a laptop is used from battery source then the battery may get discharged after two or three classes depending on the usage. In that case, either the laptop should be used from direct electrical source wherever possible or a charger trolley may be used to charge it.

## 6.2 Audio-Visual Room

As it is expensive to install an LCD projector and a computer in each classroom, many schools have established one or more audio-visual rooms. Each of these rooms is fitted with a multimedia computer and a video projector besides, access to Internet so that the teacher can

make online presentation of a web resource. Alternatively, the teacher can download it before class. A teacher has to book this room in advance. Multimedia based CDs can be shown in this room. Schools can also install video conferencing facility with other schools or experts by installing web camera and necessary software in these rooms. Refer to Case Study V on DPS (pp. 170–73) about how AV Rooms have become the most sought after place in the school. With gallery style seating arrangement and good sound system, the AV room is most comfortable for viewing video clips and even movies.

### 6.3 Resource Center (Media Lab)

If teachers increasingly develop PowerPoint-based lessons and use Internet in their teaching processes and assignments, it may be appropriate for schools to have a resource center for them. For example, Hansraj Model School, New Delhi, has established a resource center for teachers and it has become a hub of activities. Typically a resource center may have the following hardware:

- Four to five multimedia systems
- CD writer
- Digital camera
- VCR
- Scanner
- Color laser printer

The center should also stock CDs on encyclopedia, clip arts, and various subjects. All varieties of software such as graphics, HTML editor, publishing, statistics, etc., should be available. Besides, it should have good Net connectivity. A technical person should be available throughout to help teachers. Teachers should be allowed to come to this center anytime and work on their lessons and download material from the Net. In Ramjas School, New Delhi, one period per week has been specially allotted for each group of subject teachers so that they can come and work in the resource center. It is also been found that the teachers use that time to discuss and sort out subject related issues and concerns.

### 6.4 Infrastructure for Special Education

Most Indian schools have not yet thought of or provided additional facilities for students with special needs. In integrated education, there are likely to be children who are mentally challenged, learning-disabled, physically-challenged or are from vastly different socio-economic backgrounds in the same class. In that case, schools must invest in equipments that facilitate



learning processes of these students, for which special software are also available. For example, for blind students there is a software that can accept audio commands and also provide output in audio form. The text can be presented in bigger fonts so that partial visually impaired students can read them easily and use the computer according to their requirements. Even Braille output can be generated for blind students, while tutorial software can be useful for students with learning disabilities. As students do not feel embarrassed about their shortcomings in front of a computer, they can learn more easily with the help of technology (Hasselbring et al. 2000).

#### Box 6.2

##### How to evaluate a hardware vendor?

Use the following questions to know more about the vendor:

- Is the company well known? If so, how was it rated in the survey conducted by leading computer magazines?
- Does the company have a large installation base? Are its products proven and reliable?
- Is the company financially sound? Will it be in a position to carry on business viably for the next 5 years?
- Is it certified by any appropriate authority as a manufacturer of quality products?
- Does the company have a wide range of products and can it ensure compatibility across its products?
- Does the company have the necessary infrastructure for providing service and support? Does the company provide software training support?
- Is the company providing a comprehensive warranty of all its parts for one to three years? Does the company provide preventive maintenance?
- What are the superior product features offered by the company?

## 6.5 ICT Policy

The school must develop an ICT policy that will describe its educational philosophy and how ICT is purported to be used. The policy should cover areas such as the required infrastructure that needs to be procured and the extent and methodology of training of personnel in the use of ICT. This should also clearly indicate what would be the role of an ICT Coordinator, faculty members, and students. A principal will have to play a significant role in developing an IT policy of the school.

## 6.6 ICT Implementation

ICT implementation, if not properly planned may soon hit a road block; enthusiasm may die down and no measurable value can be achieved from such an effort. The ICT implementation in a school may proceed through the following steps:

- Identify a champion group and motivate the group to take the lead.
- Establish adequate ICT infrastructure.
- Provide training to staff members.
- Set up proper procedures and policies through bottoms-up approach.
- Evaluate both the output and process and take corrective actions.
- Keep note of the developments around and let your ICT strategies be updated accordingly.

The most desirable condition is when staff members take the lead and establish ownership of strategies and actions.

### 6.6.1 A Champion Group

As most of us are averse to change, schools don't find many ready takers for ICT. But there will still be one or two people interested to work with the new technology. A principal needs to nurture and highlight the activities of the group of technology enthusiasts initially so that others can see and slowly learn from them.

## 6.7 Management Issues

While going ahead with the ICT implementation, the principals may face some of the following issues or dilemma. They need to be resolved judiciously.

### 6.7.1 Outsource or Not?

Initially, schools in India opted for outsourcing computer education from computer vendors. This was because of the high cost involved and the lack of knowledge in the field of computers. Under the *Turnkey Contract*, a vendor was required to install sufficient number of computers, provide computer teachers, books, and consumables besides, design the curriculum and keep updating the same. However, barring a few, most vendors did a poor job and took the schools for a ride. They simply did not upgrade computers, modify syllabus, and train the teachers well. So, schools slowly started having their own computer lab, teachers, and taking charge of their computer courses. But, this shift has not been easy. Principals had to struggle to take appropriate decisions regarding procurement of hardware, preparing IT syllabus, and training of teachers, etc. And this problem still persists.

Looking at both the situations, a hybrid model may be suggested where teachers should be employees of the school. Schools may outsource equipments if they can't procure them on



their own. Maintenance of computers should be outsourced with a stiff penalty clause for poor service. However, if the number of computers is very large (say over 200), then either the vendor should be asked to provide a technician who would be always present in the school or the school should hire a technician on its own who can handle basic maintenance problems. This will ensure smooth functioning of computers.

### 6.7.2 Hardware—Branded or Assembled?

Though it may be a minor issue, yet school administration faces this dilemma and a wrong decision may be disastrous in the long run. Assembled machines cost less and thus schools are tempted to opt for them. But there are risks involved in buying such hardware. It is not possible to be sure about the origin of assembled products and at times refurbished hard disks are sold as if they are new. For a layman, it is difficult to differentiate between a new or refurbished hard disk. On the other hand, if the hardware is genuine, one not only does one get a good product, but also at a lower cost with local support and service. So in the purchase of hardware, the credibility of the supplier is important and the availability of prompt maintenance support is the key factor.

### 6.7.3 Access to Facility from Outside

Most of the universities abroad allow their students and faculty to access university computers from home. This facilitates better learning. However, this requires the institute to have campus wide network and adequate security system. As and when the schools start providing similar services, they have to lay down proper network and security mechanism. It will also be worth an exercise to find out if such a facility will help in teaching-learning processes of the students and teachers.

### 6.7.4 Assessing Software

It has already been established that schools must put efforts to identify and then procure appropriate software. For this, the following four aspects must be taken into consideration:

- Content
- Media production (formatting aspects)
- Instructional design (learning outcomes)
- Delivery and student support

Similarly, Internet resources can also be evaluated for their quality and appropriateness. See Box 6.3–6.5 for criteria for evaluating various resources like Website, CD-ROMs, and software. Also, it is important that the prices are compared for similar programs.

### Box 6.3 How to evaluate Website

#### Content

##### Accuracy:

- Error-free information
- Current information
- Updated frequently
- Recent 'last' update
- Objective, balanced presentation of information
- Bias-free viewpoints and images
- Correct use of grammar: spelling, and sentence structure
- Primary outlook (link that takes you to additional site) content is relevant, authentic, and appropriate
- Authority
- Expertise/reputation of author/designer
- Contact information for author/designer
- Expertise/reputation of host site

##### Appropriateness:

- Concepts and vocabulary relevant to students' abilities
- Information relevant to the curriculum
- Interaction compatible with the physical and intellectual maturity of intended audience

##### Scope:

- Information of sufficient scope to adequately cover the topic for the intended audience
- Logical progression of topics within original site (site being evaluated) and primary outlooks
- Information offered not easily available in other sources

#### Technical Aspects

##### Navigation:

- Ready access to site: site not overloaded
- Images load within reasonable timeframe
- Intuitive icons, menus, and directional symbols that foster independent use
- In-links (links that take you to locations within the original site) that allow easy navigation throughout the site
- Standard multimedia formats
- Logical options for printing/downloading all or selected text and graphics

(Box 6.3 continued)



(Box 6.3 continued)

**Presentation:**

- Site follows good graphic design principles
- Screen displays uncluttered and concise
- Captions, labels, or legends for all visuals
- Legible text and print size appropriate for the intended audience
- Graphics and art functional, not merely decorative
- Information presented through text, motion, still images, and sound
- Information presented in a manner to stimulate imagination and curiosity
- Product advertising not intrusive

Source: <http://www.evalutech.org>

**Box 6.4**

How to evaluate a CD-ROM (from <http://www.evalutech.org>)

**Content****Accuracy:**

- Error-free information
- Current information
- Objective, balanced presentation of information
- Bias-free viewpoints and images
- Balanced representations of cultural, ethnic, and racial groups
- Correct use of grammar, spelling, and sentence structure

**Appropriateness:**

- Concepts and vocabulary relevant to students' abilities
- Information relevant to the curriculum
- Interaction compatible with the physical and intellectual maturity of intended audience

**Scope:**

- Information of sufficient scope to adequately cover the topic for the intended audience
- Logical progression of topics
- Variety of activities, with options for increasing complexity

**Technical Aspects****Navigation:**

- Rapid retrieval of information and screen transitions
- Intuitive icons, menus, and directional symbols that foster independent use
- Controllable pace, including options for stop/pause/exit
- Controllable sound and narration that can be turned off separately
- Search paths for return to previous screens viewed

(Box 6.4 continued)

*(Box 6.4 continued)*

- Easy access to cross references, additional information
- Two levels of searching (including Boolean strategy), when appropriate
- Bookmark and highlighting features, when appropriate

**Save/Record-Keeping Features:**

- Logical options for printing/downloading all or selected text, and graphics
- Save feature for search results, when appropriate
- Save options for games or activities in progress
- Note-taking feature, when appropriate
- Record-keeping feature to monitor student progress

**Presentation:**

- Information presented through text, motion, still images (slides, diagrams, drawings, paintings, etc.), sound
- Information presented in a manner to stimulate imagination and curiosity
- Activities that provide opportunities for creative problem solving
- Use of appropriate and supportive feedback
- Options for help, tutorial segments
- Uncluttered screen displays
- Captions, labels, or legends for visuals
- Legible text and print size that is appropriate for the intended audience

**Quality:**

- High quality visuals relevant to the content
- High quality audio and video consistent with state-of-the-art reproduction capabilities
- Sound that is clearly understandable and consistent in quality and volume
- Sound and music that is relevant to screen displays

**Documentation****Technical Information:**

- Descriptions of specific hardware requirements for operating the application
- Instructions for installation and operation
- Instructions for search and help features
- Toll free technical support telephone number

**Teacher's Guide:**

- Description of target audience
- Summary of the contents of the application
- Instructional and/or behavioral objectives
- Suggestions for classroom use, lesson plans, related activities
- Ancillary materials for student use, such as camera-ready worksheets and activity pages

Source: <http://www.evalutech.org>



**Box 6.5**  
**How to evaluate Computer Courseware**

**Content****Accuracy:**

- Error-free information
- Current information
- Objective, balanced presentation of information
- Bias-free viewpoints and images
- Balanced representations of cultural, ethnic, and racial groups
- Correct use of grammar, spelling, and sentence structure

**Appropriateness:**

- Concepts and vocabulary relevant to students' abilities
- Information relevant to the curriculum
- Interaction compatible with the physical and intellectual maturity of intended audience

**Scope:**

- Information of sufficient scope to adequately cover the topic for the intended audience
- Logical progression of topics
- Variety of activities, with options for increasing complexity

**Technical Aspects****Navigation:**

- Rapid retrieval of information and screen transitions
- Intuitive icons, menus, and directional symbols that foster independent use
- Controllable pace, including options for stop/pause/exit
- Controllable sound

**Save/Record-Keeping Features:**

- Options for printing/downloading text
- Save option for games or activities in progress
- Note-taking feature, when appropriate
- Record-keeping feature to monitor student progress

**Presentation:**

- Information presented in a manner to stimulate imagination and curiosity
- Activities that provide opportunities for creative problem solving
- Use of appropriate and supportive feedback
- Options for help, tutorial segments
- Uncluttered screen displays

*(Box 6.5 continued)*

(Box 6.5 continued)

- Captions, labels, or legends for visuals
- Legible text and print size that is appropriate for the intended audience

**Quality:**

- Visuals relevant to the content
- Sound that is clearly understandable and consistent in quality and volume
- Sound and music that is relevant to screen displays

**Documentation**

**Technical Information:**

- Descriptions of specific hardware requirements for operating the application
- Instructions for installation and operation
- Toll free technical support telephone number

**Teacher's Guide:**

- Description of target audience
- Summary of the contents of the application
- Instructional and/or behavioral objectives
- Suggestions for classroom use, lesson plans, related activities
- Ancillary materials for student use, such as camera-ready worksheets and activity pages

Source: <http://www.evalutech.org>

## 6.7.5 Net Policy

As schools expose students to Internet for longer duration many consequent problems are likely to arise. Thus, schools must establish a Net policy so that its misuse can be minimized and students can be made responsible for its usage. In general, teachers are concerned about the misuse of Internet facility. Box 6.6 shows the net policy of Amity International School, Saket, New Delhi.

In addition to Net policy, schools can also use net security software such as Net Nanny and CyberPetrol which prevent students from accessing unwanted sites. These are also capable of keeping track of the sites visited by the students. Teachers also can check on a regular basis if a particular student tried to visit a restricted site.



## Box 6.6

Seven smart rules for Internet safety  
Amity International School, Saket, New Delhi*I will not tell a stranger who I am or where I live*

I won't give out my name, number, address or identifying information to anyone on the Internet, even if they seem to be my friend. I will always tell my parents when someone asks for this kind of information, even if it's a cartoon character. I won't send pictures of myself to strangers online.

*Me and my parents are a team*

I will teach my parents or adults how to use the Internet. I will show them which sites I browse and what I do. I can teach them how to 'surf,' and they can teach me how to stay safe. We are a team. Teams win when they work together.

*I can say no*

I won't let other kids talk me into doing something on the Internet that my parents wouldn't want me to do. I am strong and responsible, and I might sometimes need to tell someone 'no' in order to do the right thing.

*I will share e-mails from strangers with my parents*

I will not open e-mails or look at any messages from a stranger without my parents knowing about it. If someone sends me an e-mail that is not a person my parents know, I will make sure to tell them. I will not answer e-mails from strangers unless my parents say 'OK.' I will not accept an offer to visit a Website unless my parents are there with me.

*Strangers in chat rooms can be good or bad, but they are still strangers*

I will not visit chat rooms unless my parents know about it. I know that people sometimes pretend to be 'different' on the Internet than they really are. Sometimes a grown-up might pretend to be a kid. I need to be careful, and not always believe what people say in chat rooms.

*Safe distance from strangers*

No matter where I am on the Internet, I am in a place where there are many people who can freely come and go. The Internet is like a big city. Some of these people will be strangers to me, and I will follow safety rules with them as I follow with strangers in life. There are good and bad people everywhere and I will always keep strangers at a 'safe distance.' On the Internet that means that I only do what my parents, teachers and guardians feel is OK for me to do. And it also means that I will not meet a chat friend without asking my family first and making sure they come with me.

*My family and teachers care about me—bad things on the Internet are not my fault*

If someone on the Internet says or does something bad to me, it's not my fault and if someone does that I will not answer them. I know that I can trust my parents, teachers, and other adults in my family, and I know that I can tell them right away. They will know what to do about it.

(Box 6.6 continued)

*(Box 6.6 continued)**Remember..... Play It Safe!*.....  
My Signature.....  
Dad and Mom's Signature (or whoever is responsible for me... Grandma, Grandpa, etc.)—get as many names as you can!.....  
My Teacher's Signature.....  
Congratulations! You are a great student, and you can continue to be so by sticking to the rules and sharing them with your friend to help keep them safe, too.

## Box 6.7

## A guide for parents and educators

This presentation is intended to help parents protect their children from being exploited and/or becoming victims of sexual abuse on the Internet.

***Some Warning Signs***

- Excessive use of online services of the Internet, especially late in the night
- Unsupervised time in unmoderated chat rooms
- Lots of graphic files downloaded
- Look for files ending in .jpg, .gif, .bmp, .tiff, .pcx
- Phone calls from strangers
- Gifts or money that can't be explained
- Face to face meetings with people you don't know

***Read About It***

- Two things to avoid: hysteria and complacency
- Use the resources list and tips for virtuous computing/surfing
- Buy and read a book on the subject
- Act on what you've learned

***Unique Risks Attributed to Internet***

- Access to personal information from children via chat rooms, discussions, forums, etc.
- Access by children to inappropriate material
- Unintentional smut exposure
- Mistyped URL (Address)
- Search engines

*(Box 6.7 continued)*



(Box 6.7 continued)

### **Offline Strategies**

- Bring it out in the open
- Parental involvement
- Stay in touch. Ask them to teach you
- My Rules for on-line Safety (Handout)
- Limit time and/or purpose
- Prepare for Various Access Point Situations
- Library/School/Friends
- Monitor long distance telephone bills for unknown numbers

### **Online Strategies**

- Check the history list on your browser
- Check and sort temporary Internet files in Windows Explorer
- Use filters or guardian software like: SurfWatch, CyberSitter, Net Nanny
- Use spam busters or e-mail filters
- Customize security settings through control panel options

### **Search Engines**

- The following sites, as far as we know, will not return sexually explicit, violent or hateful content
- Help us add more of such Websites if you know or remove one of them if you find any inappropriate. Let us know.

### **Safe URLs**

- <http://www.ajkids.com> (why is the sky blue?)
- <http://www.yahooligans.com> (20,000 safe sites)
- <http://www.personal.lycos.com/safetynet/safetynet.asp> (helps auto-filtering any search)
- <http://www.supersnooper.com> (protects against pornography, violence and hate)
- <http://www.studyweb.com> (73,000 'research quality' Websites)
- <http://www.lycos.com/kids> (a directory of kids' sites)
- <http://www.education-world.com> (56,000 educational sites)
- <http://www.safekids.com> (safety in cyber world)

## **6.7.6 Extending Technology to Parents**

As parents are one of the important stakeholders, efforts should be made to make them connected to the school through e-mails and Websites. It is seen that if parents are treated as partners in the development of a school, a lot of help and support can be sought from them. In the school Website, individual pages for students and parents can be created so that parents can keep track of the progress of their children. They can also know what is happening in the school. Schools can also send individual e-mails to parents asking them to participate

in school functions, their suggestions on important matters or seeking their help for a particular need, etc. If required, schools should conduct special technology awareness sessions for parents. This is what Delhi Public School, East of Kailash, New Delhi has been doing through its virtual school effort.

### 6.7.7 TCO and Cost Effectiveness

Today most of the commercial companies talk about total cost of ownership (TCO) with respect to ICT installation. The TCO will also be an important concern as schools start using computers extensively. By definition, TCO includes not only the purchase cost of hardware, software, and other equipments, but also after-purchase, direct and indirect costs (Van Dam 1999). According to Moses (2002), six after-purchase cost factors are: (1) professional development; (2) support (maintenance); (3) connectivity; (4) software; (5) replacement costs; and (6) retrofitting. Professional development refers to proper training of the staff so that they can make use of installed hardware and software in their work. Computers require both preventive and corrective maintenance. Today Net connectivity costs are very high. With changes in technology, both hardware and software may need to be upgraded from time to time. Additional devices need to be fitted into the existing computers to fulfill certain future needs. For example, a computer in the Principal's room may need to be fitted with a CD writer to enable writing of PowerPoint lessons prepared by the Principal into a CD. Normal memory card may need to be replaced with a higher capacity memory card in order to run a memory intensive graphics software. Principals have to take these cost factors into consideration when procuring hardware and software.

As ICT infrastructure is very expensive; a challenge for the school administration would be to reduce the burden of cost as much as possible. Few strategies that can be followed to achieve such goals are (<http://www.techknowlogia.org>):

- Having proper knowledge about equipments will help strike a good bargain and also get free peripherals or training.
- Schools can also explore the possibility of using its computer labs for professional courses for outsiders, thus earning some revenue for the school.
- Outsourcing of maintenance service and other non-critical activities can reduce cost.
- Partnering with private businesses and other organizations may help reduce the cost of innovation.

It may be noted that ICT does reduce the cost per student on a long-term basis, while on a short-term basis, it increases cost and involves high investment (Bates 2000).



## Box 6.8

## Some operational issues in lab management

Computer Lab with its equipments, network, and software is a complex entity. It requires deft handling if it has to be available all the time for students to use. Some of the tips provided by Reksten (2000) for effective computer lab management are as follows:

- **Responding to emergencies:** If a computer is malfunctioning at a crucial time, proper backup procedure should be organized. There should be a person who can take care of minor hardware and software problems.
- **Scheduling:** Which students will go to which lab, at what time and for how long should be planned beforehand.
- **Developing a maintenance plan:** Scheduling of preventive maintenance should be made and adhered to.
- **Hardware and software upgrades:** Depending on the requirement and availability, both hardware and software should be upgraded to ensure seamless operation.
- **Security issues:** Proper physical and software security systems should be adopted to prevent unauthorized use of resources.

## 6.8 Personnel

Besides IT teachers, for ICT implementation in a school there is a need to recruit some people with special skills. A structure and some of these positions are discussed in the following paragraphs.

### 6.8.1 Management Structure

Successful deployment of ICT may require some change in the existing management structure of the school. Each school can have the following management structure as far as ICT implementation is concerned (<http://www.ncc.co.uk>):

- Each school should have a coordinating group for ICT. This committee should look after the development of ICT policy, its implementation, and review. It should include the Principal, ICT Coordinator, ICT Manager, and representatives from various departments.
- Designate an ICT Coordinator who works with teachers and coordinates the IT deployment and usage in the entire school.
- The school should have an IT Manager who looks after the technology and reports to IT Coordinator.
- There should be technicians to support the IT Manager.

- Heads of department must ensure support of their department for the implementation of IT policy in school.

## 6.8.2 ICT Coordinator

Research has found clear support for the proposition that having an IT Coordinator helps in the smooth implementation of ICT in schools. According to Crawford (1999), the IT coordinator not only needs to have strong IT skills, he/she should be able to motivate and help teachers to use ICT in their lessons. The ICT coordinator can take forward the implementation of IT strategy of the school under the guidance of the principal.

## 6.8.3 ICT Manager

As already mentioned, the role of IT manager will be technical in nature. However, depending on the need of the school, the role of IT manager can also be taken up by the IT coordinator. Alternatively, a faculty can be the IT coordinator while a technical person can be recruited as the IT manager.

## 6.8.4 Network Administrator

Each school must employ a qualified network administrator to get the most out of the school network. Maintaining a network is a highly specialized job and cannot be handled by computer instructors. The network administrator should typically be able to maintain the network, add/delete users, take timely backups, solve network related problems, and plan network extension, etc. A graduate who has completed network certification, can work for long hours, and handle debugging problems can fit the role.

## 6.8.5 Maintenance Engineer

The school with a large number of computers may opt for having its own hardware engineer who can maintain the systems on a day-to-day basis. A diploma engineer with good hands-on expertise can be recruited as a maintenance engineer. He/she should be provided with a small stock of spare parts to take care of the computers.



## 6.8.6 Database Administrator

The case study of Apeejay School shows that the school has hired a database administrator (DBA) to manage the database of the school. With the school going in for full automation, the role of a DBA becomes very critical. The person not only helps define how the data will be stored, he/she also sets different access level for the users, stores back-up data, and perform other day-to-day activities related to database management. The person should be comfortable with the database concept and software like Oracle or SQL Server. A PG diploma or MCA qualified person can be fit for this post.

## 6.8.7 Programmers

Schools also need to recruit one or two programmers who can develop small programs for immediate and occasional needs of the school. They can also maintain the automation software installed in the school or be part of the development team, if the school has or intends to develop its own software.

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## School Website

A Website is an easy and effective tool for individuals or organizations to disseminate information about themselves to the world at large. Information can be easily updated at a lower cost. Though many schools have developed their Websites, confusion regarding the objective of a school Website continues.

A Website can be static and provide some useful information regarding the school. For example, schools can disseminate information regarding their infrastructure, management, educational philosophy, and admission policy, etc., so that an outsider can have basic information about them.

The Website can be dynamic where day-to-day information is updated on a regular basis. For example, a school in Bangalore puts its circulars on the Website (apart from sending it through e-mails) so that parents can see them anytime. Schools also put up examination results and create personal pages for students. The case study of Delhi Public School, East of Kailash, New Delhi elaborates on this. Websites can also carry articles written by students and teachers, thereby functioning like a school magazine.

The schools also can make the Website interactive by displaying information to queries put up by the students. For example, a student can put in his/her roll number and get details of his/her fee payment and performance. The site can even host e-learning lessons which can complement classroom teaching and which students can use at their own pace on their own computers at home. Besides, it can also provide links to software that students can download and use at home on their own computers. It can also extend remote access to some learning packages. Teachers can also put up lecture notes for students to download at their convenience. Schools can use Website for polling or debating over an issue. For example, the principal can put up a poster regarding burning crackers during Diwali, and every student can be asked to post their opinion about it on the Site. Finally, an e-vote can be taken. This polling concept has been successfully used by Rajmata School, Jodhpur, using intranet. Incidentally, following participation in the e-vote, a majority of students decided not to burn crackers and spend that amount for some social cause.

The Website can also have a Frequently Asked Question (FAQ) section which includes answers to basic questions put forward by prospective students and their parents. Besides, it can have a search facility using keywords.

Looking at all these functions that can be performed by a school Website, the school must decide what it would like to achieve and how to go about it. It must appreciate that a



properly designed and maintained Website can be a powerful link between all stakeholders and the school.

The choice of the nature of Website (static, dynamic, or interactive) would depend on the nature of the school (day school or residential, for example), profile of the parents of children coming to school (literate and tech savvy, literate but not tech savvy, not so literate, etc.), and the reach of the school (within the city or outside the city, etc.).

## 7.1 Certain Issues in Setting Up and Designing Websites

Besides the objective of the Website, there are certain other issues regarding the Website that also needs to be handled. Given below are some of these.

### 7.1.1 What Domain Name?

Using the domain name enables one to visit a particular Website. It is also called Uniform Resource Locator (URL). A domain name has 3 components: WWW, a name, and an extension like '.org,' '.com,' etc. The extension indicates the type of organization that is having the Website. For example, .com is for commercial organizations while .org is for non-profit organizations. A school by nature is a non-profit organization and it should not opt for .com extension. So, the domain name of a school should be <http://www.amitaschool.org> or <http://www.amitaschool.ac.in>. But, many schools have opted for domain names like <http://www.amitaschool.com>. By convention they should go for .org or other extensions like .edu or .ac.in ('.ac.in' extension refers to 'academic community in India').

### 7.1.2 Design Aspect

A Website may be the source for first level of interaction with potential students, employees, and other stakeholders. Thus, care should be taken to ensure that visitors not only find the relevant information, but also like its appearance and find the whole experience of exploring the Website pleasant. That is, a Website must look elegant and readable. It should avoid too much graphics and cluttering which makes it visually unpleasant, and delays the downloading of a page. It should provide correct and current information. In some cases, outdated information is worse than no information. The users should also not be made to put in a lot of effort to find the required information. Research shows that any information should be available within 1.5 clicks on an average. Thus, it is better to take help from a professional designer to design the templates and entrust the work of updating it to the school staff.

## 7.2 Innovative Facilities in School Website

School Website can be used to provide various innovative facilities to students and visitors. Some of those are described below.

### 7.2.1 E-zine

Schools can use the Website to publish e-magazines that contain articles, poems, and stories written by students. This can have a subscription facility too, so that an HTML page containing the topic names and a brief note on each of them along with the appropriate links to the Website can be forwarded to all subscribers through e-mail. This will not only provide the students with a medium for creative expression, but will be also cheaper, faster, and can help in building a meaningful relationship with all stakeholders of the school. The Website may keep .pdf versions of earlier editions of the magazine as part of its archive.

### 7.2.2 E-mail

School Website also can provide e-mailing facility to students. With the correct username and password, a student can send necessary e-mails. Of course the school needs to have a mail server for this purpose. This facility can also enhance brand image of the school with students sending mails through the e-mail ID linked to the school domain name.

### 7.2.3 E-commerce

Some schools also use their Website to display the products available in the school tuck shop. Students can buy those items through the school Website. In fact, they can sell some of the items they make in their art or craft classes. For example, ceramic products or paintings made by students interested in clay modelling or fine arts, can be showcased in the Website for people to buy.

### 7.2.4 Faculty Recruitment

School Website can also be used to encourage prospective teachers to apply online. The in-built software can process the applications to facilitate the recruitment process. E-recruitment has been fairly successful in commercial organizations and schools can definitely benefit from it.



## 7.3 How to Go About Developing Website

The first and foremost requirement is to register a domain name. It can be either registered with a registration company based in the USA (for example, domain names with .org) or in India (for example, domain names with .ac.in). There are no distinct advantages of having .org or .ac as the domain name. The school can ask a Website development company to register the domain name on its behalf. It is necessary to have a few options for the Website name because the one that the school wants may already be taken by somebody else. For .org, domain name one can go to <http://www.networksolutions.com> and search for the name one wants to have. For registering an .in domain name, one can check in <http://www.registry.in>.

Developing the Website can either be done at home or through a professional company. But it is better if it is maintained (modification and minor addition) by an in-house team. But before trying to develop the Website it would be a fruitful exercise to identify what needs to be put in it. One can visit other school Websites to see what generally needs to be put in, following which, keeping in mind one's own requirements, the information to be put on the Website should be defined and collected.

Finally, keeping the Website updated is the most important aspect. There should be a person or a team in the school to coordinate collection of information (news, events, circulars, etc.) from various sources and hand it over to the design team to develop or modify pages and update the site.

### Box 7.1

#### Free web space

Geocities (<http://www.geocities.com>) and some other sites (<http://www.googlepages.com>) provide free Web space for individuals and even organizations to develop web pages and host them. In return, these sites put up advertisements from where they generate some revenue. To begin with, schools can even experiment with this facility and host their school site. Once they know what they want from the site and what they intend to put up, they can go for their own domain name and web space. Geocities and Google even extend basic facilities to design pages and upload and download them.

### Box 7.2

#### Free Website designs

Open Source Web Design (<http://www.oswd.org/>) is a service that has about 1,400 free Web designs (templates). This Website also extends many more like showing how your site is going to look in different browsers and where to get good images from, etc. A school can choose from the given templates and design their Website accordingly.

## 7.4 How to Promote Your Website

Many organizations and even schools put in a lot of effort to build the Website, but later fail to promote the sites or keep them updated. To promote the site, the school must mention Website addresses in most of the documents like brochures, certificates, envelopes, letter head, and visiting card, etc. Those working in the school can even add the URL of the school Website to their e-mail signature. Parents, students, and visitors must be encouraged to visit the school Website to seek necessary information. It is also important to remember that only an updated site is visited and used by people.

In order to ensure that your school Website address is seen when people use a Google or other search engine, the school can use a free service called <http://www.addme.com>. Here one can submit the URL of the school Website with a small description of the school. This allows the school URL to be indexed by several search engines.

## 7.5 Intranet for School

Though most schools have opted for Internet facility and have set up their Websites, very few of them have exploited the benefits of intranet. Technologically, intranet is the same as Internet, but it is restricted to the school campus wide network only. However, this gives enormous facility to promote e-learning, maintain campus notice board, put up rules and regulations pertaining to various activities in the school, conduct school wide polling, etc. As this does not require extra hardware and tools than what the schools already have, principals must encourage students to develop intranet sites for clubs, magazines, and other activities.



## School Automation

'An information system collects, processes, stores, analyzes, and disseminates information for a specific purpose' (Turban et al. 1994). School Information System (SIS) is a specialized management information system (MIS) that 'matches the structure, management tasks, instructional processes, and special needs of the school' (Telem and Avidov 1994). It is a comprehensive piece of software that supports various functions of a school.

Any information system has the following components:

- Hardware
- Software
- Network
- Database
- People
- Procedures

### 8.1 Advantages of ICT Assisted SIS

Organizations now-a-days depend heavily on information systems for taking several kinds of decisions, ranging from transactional to strategic ones. The use of information system provides the following benefits (Turban et al. 1994):

- Provides fast and accurate transaction processing.
- Provides large capacity, fast access storage.
- Provides fast communication (machine to machine, human to human).
- Reduces information overload. Scans huge amount of data and provides relevant information that can facilitate decision making.
- Spans boundaries. Data can be located in various computers but the software provides information in an integrated manner without the user knowing the source of the data.

- Provides support for decision making.
- Increases competitiveness. Good information system has been a differentiator for companies.

In getting benefits from information systems schools are no different from other organizations. Some of the advantages that SIS can extend to schools are:

- Routine manual tasks can be performed faster.
- It is possible to perform certain tasks with the help of computers, which otherwise cannot be performed manually. For example, using SIS the school can find the pattern of students attending various classes.
- Some tasks that are not practically possible in a manual system can be easily accomplished. For example, at any instant the school can find how much has been spent on different heads against budgeted amounts.
- Updated profile of the students can be stored which can aid in counseling the students.

## 8.2 Components and Functions Performed by SIS

As already mentioned, School Management System is a comprehensive software which takes care of all the major functions of a school. It has several components, each handling a major function. In general, an SIS may have the following major components:

- Student information
  - Personal information about students can be stored (an example of student profile is shown in Box 8.1).
  - Students' attendance information can be recorded and analyzed.
  - Records of students' achievements and other curricular information can be stored and analyzed.
  - Planning of various school activities can be stored for reference.
- Staff information
  - Personal records of staff members can be stored.
  - Staff appraisal can be organized and results can be analyzed to decide incentives. Staff development programs can also be planned.
- School management
  - School timetable can be generated.
  - Arrangement classes can be organized by looking at staff shortage.
  - Account information can be recorded and digression between budgeted amount and actual spending can be detected.



- Inventory of all equipments can be prepared to help keep track of items that need to be replaced or stocked.
- Maintenance of buildings can be planned and monitored.
- Library activities can be automated.
- Campus messaging system can facilitate better communication between staff members and between students and staff members.
- Student assessment

#### Box 8.1 Student profile

King (2001) suggests that if comprehensive student profiles can be created using SIS, teachers can use it for many purposes, for example, tracking performance of students and their overall growth. With this data, one can assess the strength and weakness of a particular student and accordingly work out a custom-made remedial training package for him/her. The teacher can also assess the effectiveness of different pedagogies used. Also, such detailed student profiling can aid effective career counseling.

### 8.3 Developing SIS In-house Phase-Wise or All at One Time

A school can develop its school automation system in two ways. One possibility is to buy an off-the-shelf product and get a software vendor to customize it or commission a vendor to develop an integrated package for the school. The system is then installed, users are trained, and the manual and computerized systems are run in parallel for sometime. Later, complete shift to the computerized system can be made.

Another radically different approach is also possible. Each department, for instance, accounts, examination, fee collection, etc., can be encouraged to use a generic software such as, electronic spreadsheet or database management system to develop worksheets and databases as per their requirement. Once people get used to the concept of computerization, some professional programmers or a software company may be hired to use the existing knowledge base and data to develop an integrated system. The case study of Maheswari Public School, Jaipur, shows how the faculty members of the school could develop programs that took care of their daily requirements.

*For the school information system it is not always necessary to buy special software.* In fact some of the existing software like word processor, and electronic spreadsheet can be used for various aspects of school administration. For example:

- Word processor can be used to prepare all the necessary documents and letters.
- Electronic spreadsheet can be used to record financial transactions and generate various accounting reports.

- Database software can be used to store students' and teachers' data and generate various reports.
- DTP software can be used to prepare school newsletter, notices, and brochures.

All approaches have their advantages and disadvantages. While in-house development of software may help develop computer culture in the school better, using an off-the-shelf software can be less time consuming.

### Box 8.2

#### SIS—Implementation through External Agency

##### Introduction

Anand Niketan, a day boarding school, at Ahmedabad started in 1996 with only 20 children and two classes. By 2005, they had 800 children studying in Nursery to Class 12. Teaching is conducted primarily through project method and other co-curricular activities such as dance, music, and drama which are a part of everyday school activity. The school experience is based on the philosophy of providing children a stress free and an enjoyable learning experience.

Anand Niketan has been striving to achieve new standards in education. They believe that children are like seeds with the potential to grow into wonderful human beings who require little guidance and lots of love to be able to discover their own paths and create their own destinies.

##### Need for MIS of Anand Niketan

After 10 years of its operation, the management wanted to automate various time-consuming processes of different departments and integrate them into a single system. They also intended to improve the process of result generation, attendance, timetable, lesson plan, auto proxy, behavior analysis, etc., using computer software. They wanted to have systems to help them in:

- Understanding behavior of every child
- Ensuring quality education for every child even with high teacher turnover
- Reducing teachers' non-productive work
- Reducing time taken for routine tasks
- Communication with parents and meeting their expectations
- Sharing and converting individual's information into knowledge
- Using IT in school as a problem solver

In their internal discussions they felt that it would be best for them to procure a school management system.

##### Experience with MIS

Initially they bought a school management software based on Visual Basic from a local vendor for implementation in June 2005. However, within two to three months, the school realized that the product was unable to meet their specific requirements.



*(Box 8.2 continued)*

In the mean time, CEON Solutions Pvt. Ltd., which was incubated at the Indian Institute of Management Ahmedabad, focusing on providing innovative products in education sector got to know about Anand Niketan School and its need and search for an integrated school management software. CEON Solutions Pvt. Ltd. comprised of a team of more than 25 highly qualified young professionals. Their vision was to provide 'an integrated and intelligent solution which will be extensively used by teachers, students, parents, and management beyond office staff as a collaborative, simplified, problem solving, and learning platform.' They approached the management of Anand Niketan with a basic module and a game plan as to how they would develop and implement the software at the school and offered to develop a complete solution in 5-6 months time for them.

Once CEON had bagged the contract to develop a school management system for Anand Niketan, they did a pre-requirement analysis of the system. They conducted a planned survey among teachers, management, students, and staff and found that overall there was a mismatch between Anand Niketan's vision and the current software being used. They further realized that the earlier Visual Basic-based application was mainly a record-storing and report-generating software. It did not cater to solving the school problems and could be used only by people on campus where the program was installed. In addition, the program was operative only with Windows, which meant that the school needed to pay license fee to Microsoft for every computer. It was limited to just five to six modules and had several limitations.

**CEON's Process**

CEON proposed an application *I-School* for addressing problems and fulfilling the needs of Anand Niketan. *I-School* was a completely integrated, intelligent, powerful education process management solution. It had 50 modules which could run offline (within campus) and online away from school.

**I-School:**

- Facilitated the management of basic activities in the school like student and school information, timetable, result and grading management and generation, generation of ideal sitting plan in examination, canteen and inventory, and accounts management.
- Helped in detecting proxy, auto grade generation, integration with mobile for instant communication through SMS service.
- Was an analytical tool that could analyze the behavior, performance, and individual growth of students over the years.

Based on system analysis a three-phase plan was drawn up and executed to accomplish the project in 5-6 months.

**Phase 1: Pre-requirement analysis**

Complete understanding in the initial stages helped the CEON team to design a system compatible with future requirements and changes. A comprehensive report called SRS (Software Requirement Specification) was developed which included all the functional, technical, and interface related requirements of the school as suggested by module coordinators, its direct or indirect users, and administration.

**Phase 2: Development activities**

1. **Designing and verification of the proposed integrated system:** Design of process diagram of various school activities, design of overall architecture of the system, database design, and user interface design.

*(Box 8.2 continued)*

*(Box 8.2 continued)*

2. **Development and prototyping** of modules as per priority. It would involve customization of existing applications of the school and also development of new modules
3. **Implementation of modules** involving software installation on users systems, data collection or data import
4. **Technical Testing** of the software by simulating different conditions and the response of the software

### **Phase 3: Implementation activities**

1. Training was imparted to users in phases so they could understand and use the software
2. Feedback about the software was taken from the participants through interviews and surveys
3. The software then went through a process of improvement based on the above feedback
4. The final roll-out of the software was then conducted by implementing all the required modules and connecting the entire school
5. As a final step, ROI (Return on Investment) Analysis regarding the effectiveness of the software in the school was conducted and a rigorous check on whether the initial objectives had been met or not was done

Fig. 8.3 displays a module of I-School and Fig. 8.4 shows the I-School project implementation road map

### **Implementation of I-School at Anand Niketan**

The implementation of I-School Project in Anand Niketan School started on 1 June 2005 with great enthusiasm and expectations by the management and I-school team. All members of the management and school teachers underwent an introductory workshop in which CEON explained the working of the software. Figure 8.1 shows the different stakeholders involved in the I-School system.

It was found that 80 percent of the teachers did not have the basic exposure to computers and so could not use them. Thus, special training of one month duration was designed for teachers to help them learn the fundamentals of the computer, and programmes like MS Office and Internet. They were trained regularly in two groups of 35 teachers each, once a week. It was for 2 hours after school and the management arranged transport facilities for teachers to go back home late. It was noticed, that one month of training increased confidence among teachers in using computers.

In one month time CEON designed basic modules of I-School for student information, HR information, academic plan, result, timetable, attendance, dynamic website of school. Training for basic modules was given to teachers, staff, and management for 2 months. During training, feedback was collected to further customize the software. The use of the basic modules helped teachers to prepare results through software in one day, as opposed to one to two weeks when manually done. It made attendance and searching of information quick, easy, and reduced duplication of work.

In phase II, a Communication Channel was developed to empower administrators, teachers, and parents to work on a collaborative platform and to be able to generate an instant snapshot of various activities in the school. It incorporated mail and messaging, circulars, news forum, integration with mobile (SMS), and bulletin board, etc.

At the request of the school management of Anand Niketan, I-School introduced behavioral analysis to be included in the report card. A workshop was conducted for four to five days to train teachers to generate and interpret the behavioral analysis. The new report card thus included academic and non-academic performance, behavioral analysis and physical report about children. It also had graphical representation of students' performance and class performance with all aspects covered in one page, which was highly appreciated by parents. Detailed report card was available online also. Figure 8.2 shows some reports/charts generated by the package.

*(Continued)**(Box 8.2 continued)*



(Box 8.2 continued)

Figure 8.1  
Different stakeholders in the I-School system

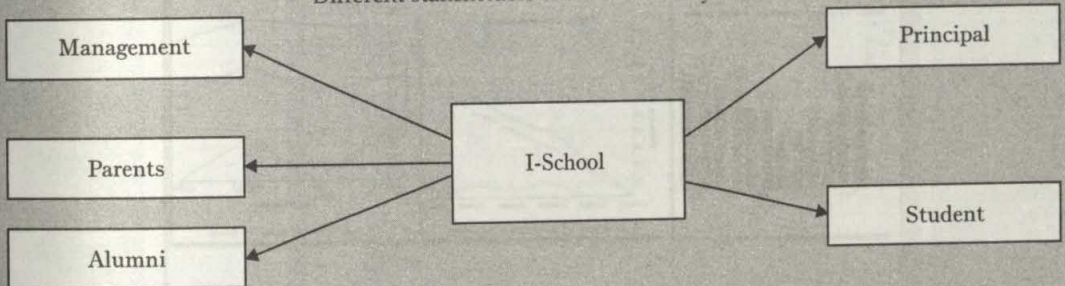
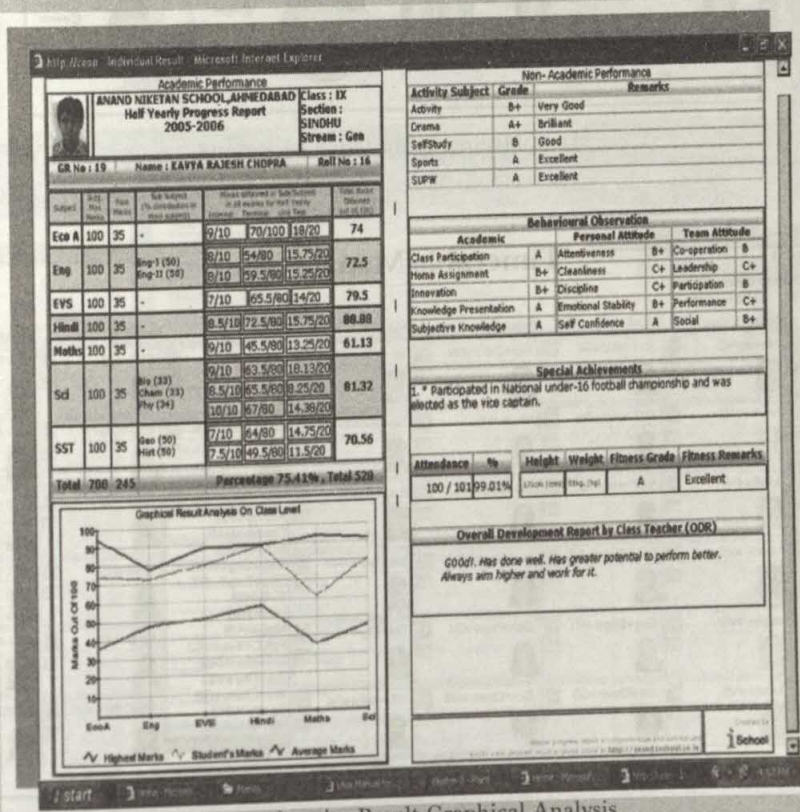


Figure 8.2  
Some reports/charts of I-School

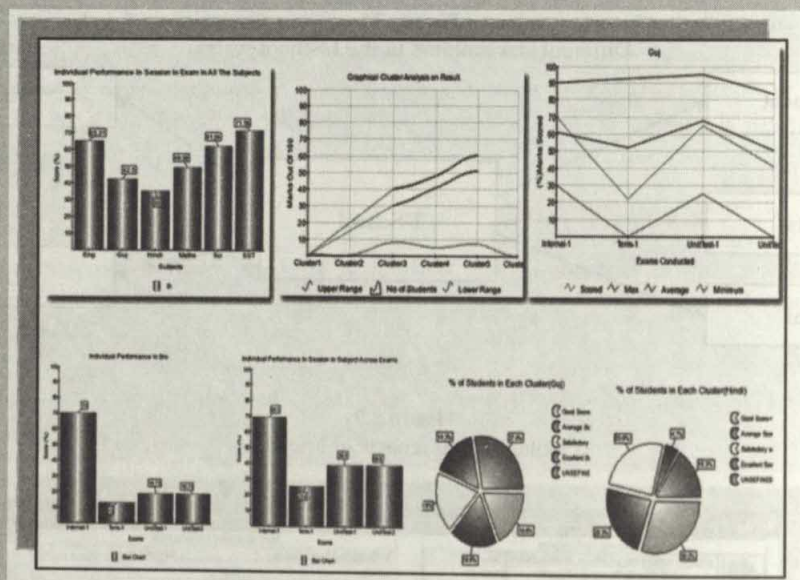


Comprehensive Result Graphical Analysis

(Figure 8.2 continued)

(Box 8.2 continued)

(Box 8.2 continued)



Data Mining + Clustering on Results

| TIME TABLE |            |             |             |             |             |             |            |
|------------|------------|-------------|-------------|-------------|-------------|-------------|------------|
| Shift      | Class      | Section     | Stream      |             |             |             |            |
| Shift-1    | IX         | SINDHU      | Gen         |             |             |             |            |
| Day        | Period : 1 | Period : 2  | Period : 3  | Period : 4  | Period : 5  | Period : 6  | Period : 7 |
| Monday     | Maths→VS   | SST→Hist→RK | Sci→Bio→VAM | Sci→Bio→VAM | Hindi→NS    | EVS→GB      | SUPW→RK    |
| Tuesday    | Maths→VS   | SST→Hist→RK | Hindi→NS    | Sci→Bio→VAM | SST→Geo→SS  | Eng→Eng→RT  | Eco A→NKS  |
| Wednesday  | Maths→VS   | SST→Hist→RK | Sci→Phy→VSJ | Eco A→NKS   | SST→Geo→SS  | Hindi→NS    | Eng→Eng→RT |
| Thursday   | Maths→VS   | Eng→Eng→RT  | Sci→Phy→VSJ | Sci→Bio→VAM | Eng→Eng→RT  | Hindi→NS    | SST→Geo→SS |
| Friday     | Maths→VS   | Eng→Eng→RT  | Sci→Phy→VSJ | Sci→Phy→VSJ | Maths→VS    | Hindi→NS    | Eco A→NKS  |
| Saturday   | Maths→VS   | Sci→Chem→GB | Sci→Chem→GB | SST→Hist→RK | Sci→Chem→GB | PBC PRA→VSJ | PBC PRA→VS |

Timetable Management

(Figure 8.2 continued)

(Box 8.2 continued)



(Box 8.2 continued)

| 2008-01-04, Wednesday |                                                                                                                      |                                                                                                                         |                                                                                                                        |                                                                                                                             |
|-----------------------|----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Absent Teachers       | <br>Bina Anand<br>Primary           | <br>Pooja Mathur<br>Middle             | <br>Sande Subramaniam<br>Secondary    | <br>Dandina Vasudeva Rajasekhar<br>Primary |
| PROXY                 |                                                                                                                      |                                                                                                                         |                                                                                                                        |                                                                                                                             |
| Period-1              | <br>B-URANUS-Gen<br>RD, UT= Lib     | <br>V-GANESA-Gen<br>APD, UT= Comp      | <br>VIR-KARNADA-Gen<br>NAT, UT= Sci   |                                                                                                                             |
| Period-2              | <br>V-EUPITER-Gen<br>SC, Eng= Hindi |                                                                                                                         |                                                                                                                        |                                                                                                                             |
| Period-3              | <br>V-NEPTUNE-Gen<br>SC, Eng= Music | <br>VIR-NARMADA-Gen<br>SC, Eng= Hindi  |                                                                                                                        |                                                                                                                             |
| Period-4              | <br>B-URANUS-Gen<br>NAT, SST= Drama | <br>VIR-KAVERI-Gen<br>APD, SST= Comp   |                                                                                                                        | <br>V-EUPITER-Gen<br>NAT, SST= Comp        |
| Period-5              |                                                                                                                      | <br>VIR-VISHNVA-Gen<br>APD, SST= Hindi | <br>VIR-SINDHU-Gen<br>APD, SST= Hindi | <br>VIR-EARTH-Gen<br>NAT, SST= Drama       |
| Period-6              |                                                                                                                      |                                                                                                                         |                                                                                                                        |                                                                                                                             |

Auto Proxy

|                                                                                   |                             |             |
|-----------------------------------------------------------------------------------|-----------------------------|-------------|
| Photo                                                                             | Student Name                | Class       |
|  | (933)<br>ADITYA SUDHIR JAIN | III         |
| Session                                                                           | Date                        | Exam Type   |
| 2007-2008                                                                         | 2008 01 04                  | Half Yearly |
| <b>Behaviour Aspect (Academic)</b>                                                |                             |             |
| Attributes                                                                        | Grade                       | Remarks     |
| Class Participation                                                               | A (Excellent)               |             |
| Home Assignment                                                                   | A (Excellent)               |             |
| Innovation                                                                        | B+ (Very Good)              |             |
| Knowledge Presentation                                                            | B+ (Very Good)              |             |
| Subjective Knowledge                                                              | A (Excellent)               |             |
| <b>Behaviour Aspect (Personal Attitude)</b>                                       |                             |             |
| Attributes                                                                        | Grade                       | Remarks     |
| Attendance                                                                        | A (Excellent)               |             |
| Cleanliness                                                                       | A+ (Brilliant)              |             |
| Discipline                                                                        | A (Excellent)               |             |
| Emotional Stability                                                               | B+ (Very Good)              |             |
| Self Confidence                                                                   | A (Excellent)               |             |
| <b>Behaviour Aspect (Team Attitude)</b>                                           |                             |             |
| Attributes                                                                        | Grade                       | Remarks     |

Behavior Analysis

(Figure 8.2 continued)

(Box 8.2 continued)

(Box 8.2 continued)

(continued)

Online Daily Lesson Plan for Period no. 3

|                                     |                                                                                                                                                                                                                                                      |                                                                                                            |                                                    |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| Class: III                          | Stream/Section                                                                                                                                                                                                                                       | Subject: Sci                                                                                               | Sub Subject: null                                  |
| Select Topic<br>Environment         | Selected Topic<br>Environment                                                                                                                                                                                                                        | Select Teaching Aid<br>AUDIO<br>E-LEARNING MATERIAL<br>WORK CARD<br>Add New Teaching Aid                   | Selected Teaching Aids<br>BLACKBOARD, WORK SHEET   |
| Add New Topic                       |                                                                                                                                                                                                                                                      |                                                                                                            |                                                    |
| Select Sub Topic<br>Country Around  | Selected Sub Topic<br>Country Around                                                                                                                                                                                                                 | Select Teaching Methodology<br>Case Study<br>Story Telling<br>Games & Play<br>Add New Teaching Methodology | Selected Teaching Methodologies<br>Quiz, Practical |
| Add New Sub Topic                   |                                                                                                                                                                                                                                                      |                                                                                                            |                                                    |
| Select Book Name<br>General Science | Selected Books<br>General Science                                                                                                                                                                                                                    |                                                                                                            |                                                    |
| Add New Books For Reference         |                                                                                                                                                                                                                                                      |                                                                                                            |                                                    |
| Description                         | 7. Myanmar- There is a river called Irrawaddy.<br>1. Pakistan- There is a big gate called Alaknanda gate.<br>2. Sri Lanka- The main language of Sri Lanka is Sinhala most people speak Tamil.<br>3. Nepal- The world's largest mountain is in Nepal. |                                                                                                            |                                                    |
| Assignment                          | 4. China- The capital of China is Beijing.<br>5. Bhutan- There is a monastery where monks work, live and study.<br>6. Bangladesh- The capital of Bangladesh is Dhaka.<br>7. Myanmar- There are 50% of Buddhist.                                      |                                                                                                            |                                                    |
| Document1                           | Browse                                                                                                                                                                                                                                               |                                                                                                            |                                                    |
| Document2                           | Browse                                                                                                                                                                                                                                               |                                                                                                            |                                                    |
| [Add] [Close]                       |                                                                                                                                                                                                                                                      |                                                                                                            |                                                    |

Robust Lesson Plan

They developed an I-School integrated SMS system to send instant information to parents on mobile about their child's attendance record. Every time a child was absent, the parent received an SMS with the current attendance record of the child. This increased the awareness regarding importance for regularity of the children. It also helped parents to take corrective action in case the child missed the bus or just did not show at school. Auto SMS was further used for result update, circular, news about school to parents. I-School also developed a routine for helping the school to address complex problems like automatic proxy, leave management linked with payroll, projects, homework, and PTA (Parent Teachers Association) management.

In phase III question bank, online exam, projects and assignments submission were being developed. Online PTA was introduced to help parents interact with teachers with ease. Four to five workshops were arranged for parents to involve and increase awareness about the software. This helped them realize their role in collaborating with the school system. Analysis of class participation and behavior in school of children was used to judge the strengths and weaknesses of the students. Also effectiveness of teachers was judged through online teachers assessment form by students.

Using I-Schools' data collection module, a lot of data was gathered but it was required to be analyzed scientifically to be of any use. For this, I-School introduced data mining tools to uncover the knowledge base of each student

(continued)

(Box 8.2 continued)



(Box 8.2 continued)

and understand behavioral growth of the child and correlation of personality development with various activities. It implemented advance result analysis (cluster analysis for finding group composition of each class), behavioral analysis (pattern analysis on change of behavior over time), activity performance analysis, attendance, etc. This introduced a totally new way of understanding each and every student using multiple perspectives.

While the software was being implemented, the associated IT infrastructure was built simultaneously. Fifty computers in various departments and computer lab were networked with CAT 6 cabling with 1 GB bandwidth. The school used broadband connection. It planned to create two wireless zones for teachers to use Internet and intranet anywhere on campus. I-School team has been successful in transforming this school and assisted its management and teachers in judicious implementation of technology for improving quality of education.

#### **Accomplishment of I-School by February 2006**

- Students could raise queries online, giving online tests.
- Attendance, results, and report card preparation was being done using I-School; teachers were free to be able to pay attention in understanding each student and help in their development. Besides, they had developed expertise so that they could learn new modules themselves and could also train new teachers.
- For administrative staff, it had become very easy to prepare timetable, making substitute arrangements, HR functions such as salaries, leave management, etc.
- Management was able to get wider information from the various reports to help them improve on weak areas.

#### **Output realization after I-School implementation**

- |                                                          |   |                                                        |
|----------------------------------------------------------|---|--------------------------------------------------------|
| • Result automation                                      | : | Two days instead of two weeks                          |
| • Timetable generation                                   | : | One week instead of one month                          |
| • Proxy making                                           | : | 30 seconds instead of 30 minutes                       |
| • Replacement of teacher                                 | : | One day instead of one week                            |
| • Result cluster analysis                                | : | Anytime instead of never done                          |
| • SMS                                                    | : | New service for parents                                |
| • Teacher's time saving                                  | : | 40 percent                                             |
| • Management access to information                       | : | 10 times more and quicker                              |
| • Feedback and Analysis                                  | : | Instant                                                |
| • Online Examination                                     | : | Quick analysis, saves hours of question paper checking |
| • Instant communication                                  | : | Intra mailing system for education                     |
| • New teachers can develop familiarity about 40 students | : | 2-3 days instead of 2-3 weeks                          |
| • Increase in parent's satisfaction level                |   |                                                        |

It was envisaged that I-School in future would be able to help in:

- Asset management
- Developing course material
- Bar code enabled library management and document management

(Box 8.2 continued)

*(Box 8.2 continued)*

- Work on OMR, i.e., optical mark recognition (answer sheet scanning and evolution) and fingerprints
- Integrating with e-Learning (I-School team and Eureka eLearning company were both working together to integrate e-Learning with I-School)

The following benefits had accrued to all stakeholders:

#### **Common benefits to all**

- Eliminated bottlenecks in the process of getting information from a pile of data
- Reduced stacks of files
- Improved system's response to the demand of the stakeholders
- Integrated solution to manage academic, administrative, and business processes
- Saved the staff time spent in manually filing, retrieving, compiling, posting paper records

#### **Benefits to students**

- Knew exactly how they were doing in any subject at any time
- Could check school calendar, homework, assignments, and announcements
- Could view books available in the library
- Could access reference material and information about careers
- Project and assignment information
- Communication with teachers and friends
- Alumni interaction with school

#### **Benefits to teachers**

- Improved teaching
- Detail timetable access
- Greater focus on teaching and less on time consuming administrative functions, for example, student records, class schedules, reports, attendance, etc.
- Could track detailed history of student's performance
- Instant communication with other teachers, students, parents, and administration
- Could develop lesson plan, using question bank

#### **Benefits to parents**

- Instant access to all the information related to their child
- Could monitor the performance of their child from anywhere, anytime on the Internet
- Could view grades, attendance, fee status
- Could see exam schedule, announcements
- Improved quality of interaction between parents and teachers

#### **Benefits to administration**

- Minimization of repetitive activities
- Instant access to information required for decision making

*(Box 8.2 continued)*



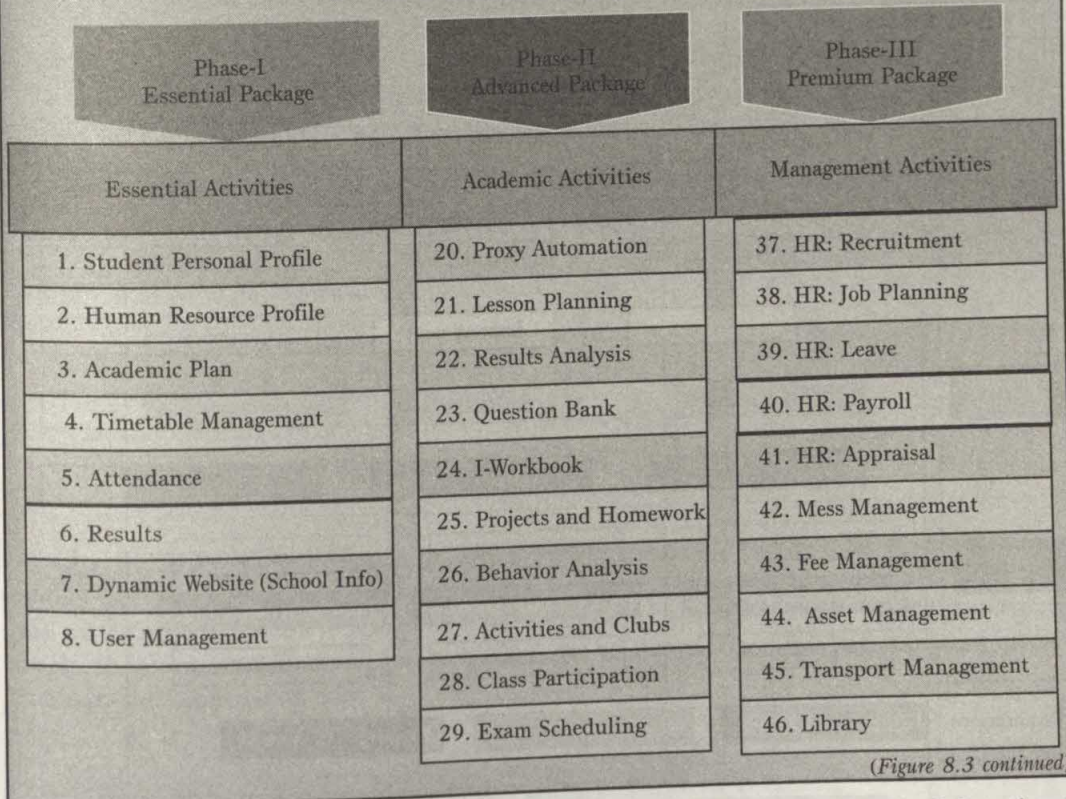
(Box 8.2 continued)

- Dynamic generation of tasks with pop-up, alerts, and e-mail provides better productivity and work plan
- Direct access to every piece of first-hand information allows to take decisions accurately
- Could pinpoint source of problems such as pilferage and wastage
- Could view any kind of reports, be it daily, weekly, monthly, or annually

Factors that helped in the implementation of I-School:

- Proper requirement analysis
- Effective training of all stakeholders
- Putting in the necessary infrastructure
- Involvement of the school principal and school management

**Figure 8.3**  
Modules of I-School



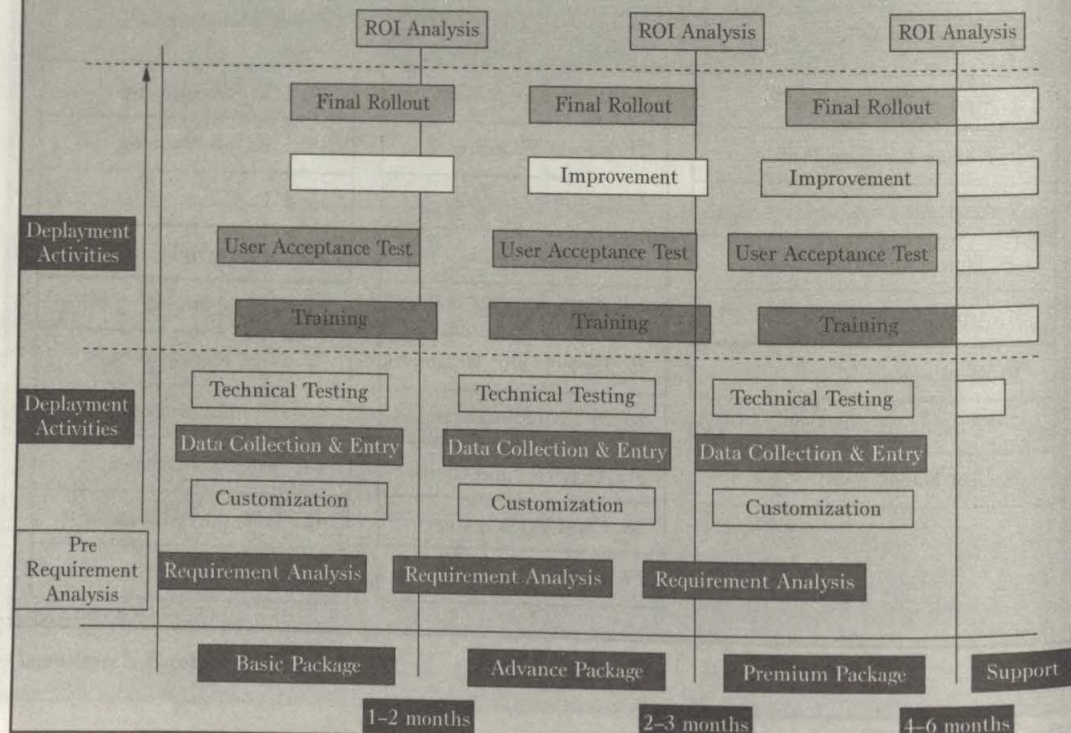
(Figure 8.3 continued)

(Box 8.2 continued)

(Box 8.2 continued)

| Communication Related         | Student Administration | Business Intelligence                  |
|-------------------------------|------------------------|----------------------------------------|
| 9. Mail and Messaging         | 30. Admission Process  | 47. MIS Analytical Reports             |
| 10. News                      | 31. Withdrawal and TC  | 48. Data mining tools on 10-15 modules |
| 11. Circulars                 | 32. Alumni             | 49. Business Intelligence              |
| 12. Forum and Poll            | 33. PTA Management     | 50. Knowledge Management               |
| 13. SMS                       | 34. Health             |                                        |
| 14. Picture and Video Gallery | 35. Student Leave      |                                        |
| 15. Calendar and Scheduler    | 36. Hostel Management  |                                        |
| 16. Bulletin Board            |                        |                                        |
| 17. Guest Book                |                        |                                        |
| 18. Feedback System           |                        |                                        |
| 19. Auto B'day wish           |                        |                                        |

**Figure 8.4**  
Road map of I-School implementation





## 8.4 Purchasing Procedure

Purchasing an SIS software may not be very easy. It is not possible to buy whatever is offered in the shop. The following steps need to be considered before procuring a readymade software:

- Carry out a need analysis to determine what is required from SIS and then clearly specify the requirements.
- Develop an evaluation criterion that will help find which software suits the school better. It may be a good idea to learn from schools that have been using SIS to understand how it is functioning in their school.
- From the various software available, find out which one matches both the requirements and the budget.
- Ask vendors to give a demonstration or send an evaluation copy.
- Negotiate the price and other services with the vendor of the product that is finally decided on, before placing the purchase order.
- Get the vendor to agree to debug all the problems with the software.
- See if there is a facility to install a helpline where a user can call up and seek assistance. Check if there is an inbuilt help facility in the software.

### 8.4.1 Services from the Software Vendor

While purchasing SIS software, schools must make sure the following services are offered by the vendor:

- Installation of the software.
- Initial training of the staff use to the software.
- Comprehensive user manual for the software.
- Warranty for a certain period during which all bugs are taken care of.

Overall, SIS helps principals to develop schools as better functioning organizations. It is also likely to bring in a change in the school culture (Bates 2000). Whether the change will be for good or for worse would depend on the principal; his research before undertaking a School Information System project, his/her own understanding of the system, and involvement in the implementation.

## 8.5 Challenges Associated with SIS Implementation

For success of any IT project, proper implementation is the key. One needs to identify the bottlenecks and know how to handle them efficiently. Bober (2001) suggests the following

pre-requisites and challenges that need to be handled for the successful implementation of SIS:

- *Development of a shared vision as foundation for subsequent decision making:* All individuals involved must understand the school's needs and develop systems that would be acceptable to all.
- *Planning cycles that are comprehensive and long range:* Installation of SIS must be treated like any other long-term infrastructure investment.
- *Awareness of SIS's associated costs among all users:* One should not only know the cost of procuring the software, but also the cost involved in training, documentation, and other associated activities.
- *Recognition of resulting cultural changes:* SIS may bring in changes in data flow, responsibilities of staff members, performance, and time management expectations. The principal must make an effort to prepare affected people for the change. The impact of SIS on school culture is included in Box 8.3.
- *Thoughtful and comprehensive training opportunities:* Staff must be trained to use the system's output effectively to improve the school pedagogically and administratively. Improper and inadequate training may add to dissatisfaction of users.
- *Recognition of data sensitivity:* Users must understand that some data are private and must be restricted to use by certain people.

#### Box 8.3

##### Impact of SIS on school culture

According to Bober (2001), SIS not only brings in productivity, but also affects the existing school culture by extending the following benefits:

- Improved communication within and across levels of school staff
- Improved relation with the larger community
- Informed decision making (functional as well as curricular)
- Teacher empowerment

## 8.6 Disadvantages of ICT Assisted SIS

There are always two sides to a coin. SIS has also its share of associated problems. It is good to be aware of them and work out a strategy to reduce their impact. Some of the disadvantages of SIS are:



- SIS can be expensive to establish.
- There may be resistance from staff to switch over to SIS as it may increase workload of some people and reduce power of some.
- Software may be inflexible, forcing the school to change its style of working.
- Shifting to totally automated systems can be time consuming.
- Hardware problems may disrupt work sometimes.
- Software may not perform the way the school really wants.
- Software from various vendors may not be compatible with each other thus causing problem in data exchange between them.
- Unauthorized users may get access to confidential data.
- Inputting data to SIS sometimes can be time consuming and expensive.

## 8.7 Extending SIS to Virtual School

SIS can also be enhanced to work as a virtual school where students can download assignments, e-mail their teachers for clarifications, and participate in group discussions. According to Rajsekhar and Bhattacharjee (2000), apart from students, both parents and teachers are happy with the virtual school system. Teachers feel that there is no need to dictate notes. Digitized content can be uploaded anytime. Parents feel that through the Net they can get to know the homework assigned to their children and they can also contact teachers any time, if required, through e-mails.

Principals may explore this possibility and take this step when the SIS in school has reached a matured stage and is ready for extension.

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## CASE STUDY IV

### SIS: Within School Development (Maheswari Public School, Jaipur)

#### Introduction

Maheswari Public School (MPS) promoted by Shri Maheswari Samaj was established in July 1977 in the Jawahar Nagar area of Jaipur. Shri Maheswari Samaj was a social welfare organization of Maheswari community. In order to promote education in the community the Samaj had promoted many educational institutions in different parts of the country. In Jaipur, besides Maheswari Public School, it had established three other schools: Shri Maheswari Senior Higher Secondary School (1956), Maheswari Girls Senior Secondary School (1960), and Maheswari Girls Public School (2001). It had also established Maheswari School of Computing (1996) for providing computer hardware and teachers in the above four schools (See *Exhibit-1* for The Education Committee of the Maheswari Samaj [Society], Jaipur).

Maheswari Public School is affiliated to CBSE (Central Board of Secondary Education) and it is also an accredited institute of both the National Institute of Open Schooling and for O level program of DOEACC<sup>1</sup> (Department of Electronics Accreditation of Computer Courses), New Delhi. The school had a student strength of 2,800 and a teacher strength of 125 (in approx. 2001–02) (*Exhibit-2* presents the growth of the student and staff strength over the years). In +2 (Class XI and XII), it offers both science and commerce streams. The school campus measures 11,400 square yard with a carpet area of 1.25 lakh sq. ft. There are altogether 59 sections with classes from I to XII. The School has Physics, Chemistry, and Biology labs with all the necessary equipments and materials for smooth conducting of experiments as prescribed by the Board. The school has also installed closed circuit television (CCTV) system so that the principal sitting in his/her office can find out what is happening in any of the classes. Similarly a two way public address system to address one/more/all rooms have been installed.

<sup>1</sup> DOEACC is an autonomous body of the Department of Information Technology, Government of India, established to bring the most updated global industry relevant computer education within the reach of more people in the areas of information, electronics, and communication technology.



# Exhibit-1

## Maheshwari Public School, Sec-4, Jawaharnagar, Jaipur

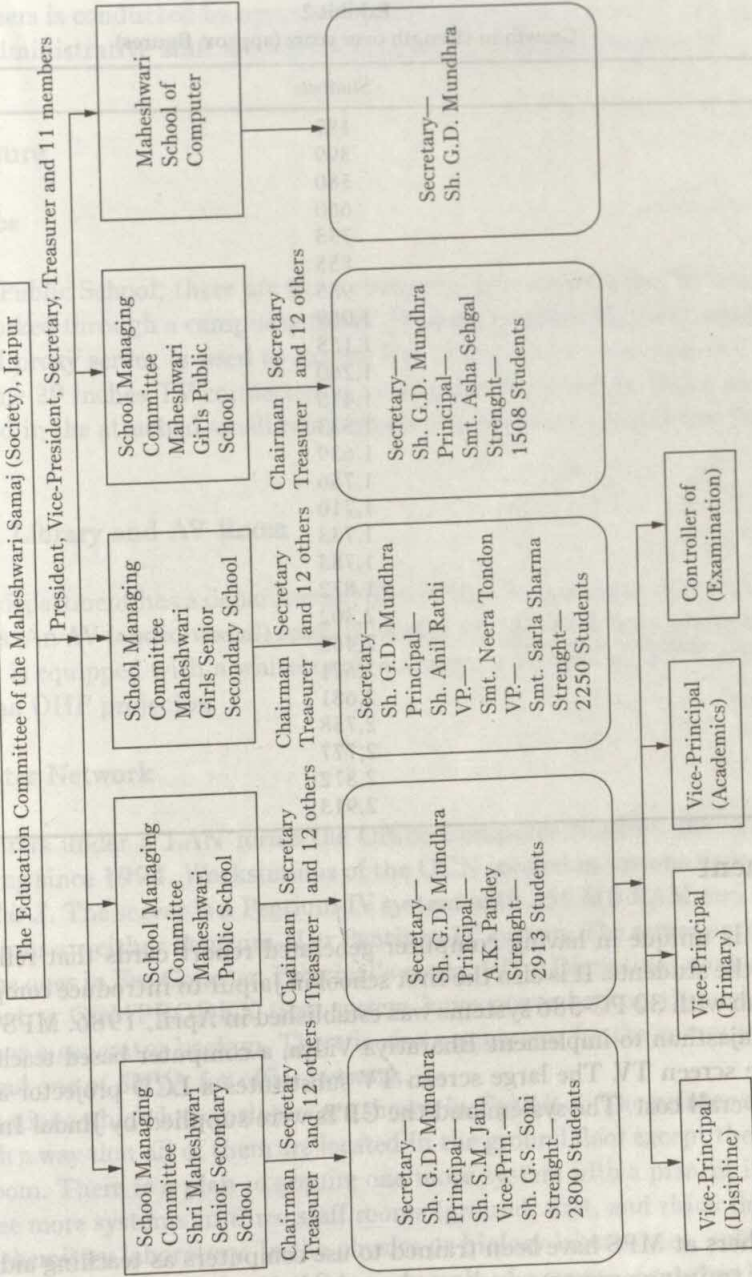


**Exhibit-2**  
Growth in strength over years (approx. figures)

| <i>Year</i> | <i>Students</i> | <i>Staff</i> |
|-------------|-----------------|--------------|
| 1977-78     | 187             | 7            |
| 1978-79     | 399             | 29           |
| 1979-80     | 580             | 45           |
| 1980-81     | 660             | 46           |
| 1981-82     | 753             | 47           |
| 1982-83     | 855             | 57           |
| 1983-84     | 935             | 61           |
| 1984-85     | 1,069           | 62           |
| 1985-86     | 1,155           | 65           |
| 1986-87     | 1,260           | 68           |
| 1987-88     | 1,415           | 75           |
| 1988-89     | 1,533           | 79           |
| 1989-90     | 1,639           | 85           |
| 1990-91     | 1,756           | 93           |
| 1991-92     | 1,710           | 95           |
| 1992-93     | 1,733           | 94           |
| 1993-94     | 1,783           | 96           |
| 1994-95     | 1,872           | 97           |
| 1995-96     | 2,302           | 98           |
| 1996-97     | 2,465           | 115          |
| 1998-99     | 2,621           | 120          |
| 1999-2000   | 2,681           | 122          |
| 2000-01     | 2,758           | 124          |
| 2001-02     | 2,777           | 125          |
| 2002-03     | 2,872           | 126          |
| 2003-04     | 2,913           | 130          |

## Achievement

The school is unique in having computer generated report cards that reflect the overall progress of the students. It is also the first school in Jaipur to introduce computers. Its first computer lab with 30 PC-386 systems was established in April, 1986. MPS is also the first school in Rajasthan to implement Bharatiya Vidya, a computer based teaching (CBT) aid with a large screen TV. The large screen TV substitutes a LCD projector and thereby reduces the overall cost. The system and the CBTs were supplied by Jindal Informatics Ltd.

## Training

All the teachers at MPS have been trained to use computers as teaching aids. Three kinds of computer training programs were conducted: (1) for computer teachers to learn the emerging technologies (2) for administrative staff in office automation work (3) subject teachers in use of computers in teaching and other routine work. One week training program for



computer teachers is conducted by external experts every year. The other two programs for teachers and administrative staff are conducted by in-house staff members.

## IT Infrastructure

### Computer Labs

In Maheswari Public School, there are three computer labs each having 30 computers. All these are networked through a campus network. Dial-up Internet facility is available in one of the labs and proxy server is used to extend Net connectivity to around 30 computers. Each lab has one 29 inches TV connected to a computer for Bhartiya Vidya program. The server is located in the attached small room which also serves as a staff room for computer teachers.

### Departmental Library and AV Room

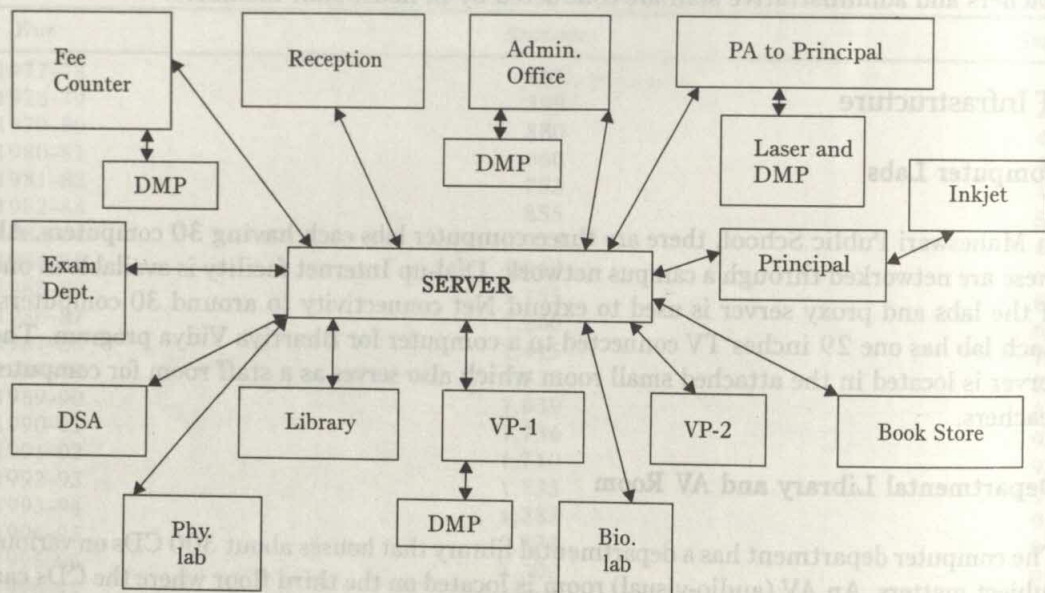
The computer department has a departmental library that houses about 300 CDs on various subject matters. An AV (audio-visual) room is located on the third floor where the CDs can be screened. It is equipped with a whiteboard, a screen, a PA system, a TV, a VCR, a slide projector and an OHP projector.

### Office Computer Network

Sixteen computers under a LAN forms the Office Computer Network (OCN). OCN has been functioning since 1994. Workstations of the OCN located in various departments are shown in *Exhibit-3*. The server is a Pentium-IV system with 256 MB RAM and 40 GB hard disk. Workstations are either Pentium-II or Pentium-IV system. The server and some workstations like the ones in Fee Counter, Principal's room, VP's (Discipline) room and the machine connected to COMPRODEX time system have power backup through UPS. The entire set-up has a generator backup. There is also a generator for the computer lab which is of 30KVA and one of 5KVA for office network.

The workstations which have printers are shown in *Exhibit-3*. The printer arrangement is made in such a way that all of them are located in the ground floor except the one in VP's (Discipline) room. There is a plan to acquire one more system with a printer in Exam Department, three more systems in three staff rooms (ground, first, and third floor) and one system in the chemistry laboratory. In the physics or biology laboratories, subject teachers use computers for making worksheets. After every unit of a course, a teacher has to give a worksheet for students to try. Teachers are also required to prepare sample answer sheets, which are given to students after the examination.

**Exhibit-3**  
Office computer Network



Time Record System (COMPRODEX was the supplier) is connected to one of the machine in PA's office (Personal Assistant to the Principal). The system in the PA's office is connected to a copy printer (Gestetner) which is used to print multiple copies of circulars and other documents. Other sister schools also use this copy printer.

A combination of star and bus topology have been used to connect the workstations to the server. CAT-5 cables are used for connectivity. Net connectivity is taken from the local ISP, Data Infosys. Using a proxy server, the connectivity has been given to the systems of the Principal, the PA and the Accountant (this is besides the Net connectivity in Computer lab). The OCN is eventually connected to the Computer lab LAN.

The School Management System is on OCN and handles a lot of administrative activities except the printing of question papers.

## School Management System

All software except accounting have been developed in-house. The evolution and the details of each software are given in the following paragraphs.



## Evolution

In 1993, the first software to be developed in-house was the Payroll System followed by the Fee Collection System and Student Registration System in 1994. Examination department software was developed in 1995. Three years later, the timetable software was developed. In 2000, leave record of staff was computerized using an in-house software, and in 2001 a software for Allocation of Streams for Class XI was developed. In 2002, Teachers Performance Monitoring System was brought into use. Since 1995, some limited computerization of seating plans for board and external examinations was being done by the Examination department using Lotus 1-2-3 program. The latest software developed was the Student Attendance System.

Most of the older software were developed using FoxPro on DOS while the latter ones were developed using Visual FoxPro. All these software were developed in-house by the PA to the Principal and some faculty members. The person who initiated this process was Mr E.V. Ajay Simha, a Geography teacher. He started it as a hobby and slowly it got converted to a full fledged and formal software development activity. He was later ably supported by Ashish Bhargava (PA), Abhilash Sharma (Comp. Sc. Dept.), Preeti Saxena (Comp. Sc. Dept.), and Ritu Sareen (Comp. Sc. Dept.). Naveen Mandhana (Comp. Sc. Dept.) helped in the conceptualization of some software. Earlier the Principal, Mr Handoo, encouraged Mr Simha in his endeavor and with the coming of the current principal, Dr A.K. Pandey, the software development process has become a formal and vital activity of the school. *Exhibit-4* details the software, developers, and the main tasks performed.

## Various Systems

All the software in school management system of Maheswari Public School use Exam Roll Number as the primary key for data storage and retrieval. Besides Exam Roll Number, a student also has an Enrollment Number which is a serial number followed by the last two digits of the year of admission (XXXXX/YY). Exam Roll Number consists of first two digits representing the class a student is currently in, the next one digit representing the section, and two more digits representing the class roll number, e.g., 01301, (Std I, Section-3, Roll No-1) or 12242 (Std XII, Section-2, Roll No-42). Each year with the payment of first installment of fee, the new Exam Roll Number for the student is generated. Enrollment Number is used only when a student is tracked across academic years.

All Databases in use are usually in shared mode. However, the rights to read/write/scan/modify/erase, etc., are set partially through FoxPro program and mostly through Novell Network user rights. Access to different directories/files is also set according to the username of Novell Network.

**Exhibit-4**

Details of some software developed in-house at MPS

| <i>S.No.</i> | <i>Software Title</i>             | <i>Language/OS</i>                         | <i>Developer(s)</i>                          | <i>Brief Description</i>                                                                                                                                                                   |
|--------------|-----------------------------------|--------------------------------------------|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1            | MPSINFO                           | FoxPro 2.5/2.6<br>MS-DOS/Novell<br>Netware | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | The main program, comprising mostly of menus and links to different modules developed at different times.                                                                                  |
| 1a           | Rollenq                           | FoxPro 2.5/2.6<br>MS-DOS/Novell<br>Netware | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | An enquiry system which allows searches based on different parameters and displays student bio-data and report card on screen/printer. Also gives class/section, roll-lists-strength, etc. |
| 1b           | Empenq                            | FoxPro 2.5/2.6<br>MS-DOS/Novell<br>Netware | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | An enquiry system which allows searches based on different parameters and displays staff details and performance on screen/printer.                                                        |
| 1c           | Mpsfee                            | FoxPro 2.5/2.6<br>MS-DOS/Novell<br>Netware | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | A set of fee programs to collect school fees under various heads/terms.                                                                                                                    |
| 1d           | Vehicle fee                       | FoxPro 2.5/2.6<br>MS-DOS/Novell<br>Netware | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | A set of fee programs to collect parking fees of scooter/cycle as well as of 19 bus routes, choose alternative routes, generate seat numbers/tickets, bus-lists, etc.                      |
| 1e           | Notice/Bulletin board             | FoxPro 2.5/2.6<br>MS-DOS/Novell<br>Netware | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | An all purpose bulletin board to inform all/specific user(s), generate alerts, etc.                                                                                                        |
| 1f           | Exam report cards                 | FoxPro 2.5/2.6<br>MS-DOS/Novell<br>Netware | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | Prints termwise report cards of classes I to XII, calculates pass/fail, ranks, etc.                                                                                                        |
| 1g           | Result analysis                   | FoxPro 2.5/2.6<br>MS-DOS/Novell<br>Netware | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | A set of more than 50 programs offering result analysis/comparative result analysis across years ... correlations, etc.                                                                    |
| 1h           | Timetable substitution            | FoxPro 2.5/2.6<br>MS-DOS/Novell<br>Netware | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | Set of programs to enter a teachers timetable, generate class-wise TT, make substitutions, etc.                                                                                            |
| 1i           | Tracking of late going to periods | FoxPro 2.5/2.6<br>MS-DOS/Novell<br>Netware | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | Helps track and fix responsibility for late arrival of teachers in periods, generate alerts, etc.                                                                                          |
| 1j           | Staff vacancy                     | FoxPro 2.5/2.6<br>MS-DOS/Novell<br>Netware | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | Programs to keep track of applications for various posts and help fill vacancies.                                                                                                          |

*(Exhibit-4 continued)*



*(Exhibit-4 continued)*

| <i>S.No.</i> | <i>Software Title</i>                    | <i>Language/OS</i>                                                                                          | <i>Developer(s)</i>                          | <i>Brief Description</i>                                                                                                                                                                                                                                                  |
|--------------|------------------------------------------|-------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1k           | TC/Char. certificate                     | FoxPro 2.5/2.6<br>MS-DOS/Novell<br>Network                                                                  | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | Programs to issue TC/CC, update<br>Scholar Register.                                                                                                                                                                                                                      |
| 11           | Misc. modules                            | FoxPro 2.5/2.6<br>MS-DOS/Novell<br>Network                                                                  | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | Small modules developed on the fly<br>using main databases but not put on<br>the menus of MPSINFO.                                                                                                                                                                        |
| 2            | Library                                  | Visual FoxPro 5/6<br>Novell Network                                                                         | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | A full-fledged Library program<br>designed to simultaneously maintain<br>two libraries.                                                                                                                                                                                   |
| 3            | Poll                                     | Visual FoxPro 5/6<br>Novell Network                                                                         | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | A network based feedback program<br>for eliciting opinions of staff and<br>students and presenting detailed<br>analysis of responses.                                                                                                                                     |
| 4            | Lottery                                  | Visual FoxPro 5/6                                                                                           | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | A program to generate/store/print/<br>display lottery results held during<br>school fair.                                                                                                                                                                                 |
| 5            | Subject<br>allocation                    | Visual FoxPro 5/6                                                                                           | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | A module developed to help in<br>allotting faculty/subject for students<br>of Std. IX and Std. XI. Has also been<br>adapted for selections in entrance<br>tests.                                                                                                          |
| 6            | Unit tests                               | Version-1<br>FoxPro 2.5/2.6<br>MS-DOS/Novell<br>Network<br>Version-2<br>Visual FoxPro 5/6<br>Novell Network | Mr E.V. Ajai Simha and<br>Mr Ashish Bhargava | Essentially an MCQ bank with a<br>front end of setting subject/class/<br>blueprint by teacher and answering<br>on line by students and updation of<br>marks to the marks database of Exam<br>Dept. Developed for conduct of<br>paperless exams, 'nil' evaluation<br>time. |
| 7            | Student<br>attendance                    | Visual FoxPro 6<br>Novell Network                                                                           | Mrs Ritu Sareen                              | Maintains on-line student<br>attendance, generates letters, and<br>monthly reports.                                                                                                                                                                                       |
| 8            | Employee<br>leave                        | Visual Basic 6                                                                                              | Mrs Ritu Sareen                              | Maintains on-line different kinds of<br>staff leave (CL, ML), and generates<br>reports.                                                                                                                                                                                   |
| 9            | Task scheduler                           | Visual FoxPro 6                                                                                             | Mrs Preeti Saxena                            | Maintains a record of staff tasks<br>assigned/completed, and generates<br>reports/alerts on over-due tasks.                                                                                                                                                               |
| 10           | Visitor record<br>(Under<br>Development) | Visual FoxPro 6                                                                                             | Mrs Preeti Saxena                            | Maintains a record of visitor<br>complaints/requests, action taken,<br>and generates reports/alerts on over-<br>due complaints/requests.                                                                                                                                  |

### *(a) Student Registration System*

It is the first system that the school's customers (parents and students) come across. It starts with the buying of an application form where data such as the student's name, his/her parent's name, address, application number, and the class to which admission is sought is recorded. This system generates the admission test list. After that, the admission test, results are entered and a list of successful candidates is prepared. This system completes its work with the completion of the admission process. The data from this system is exported to fee collection system and student information database in order to avoid duplication of efforts and data entry errors.

### *(b) Fee Collection System (FCS)*

Fee is collected four times in a year. Parents can pay all the four installments in one go. The FCS gets its database from the student registration system. The system generates various reports like collection by operators (for reconciliation), collection by day, defaulters' list, fine details because of late payment, etc. It also has the provision to accept bus fee and parking charges, etc. The number of transactions have increased from 150–200 in manual system to 400–450 per operator in this automated system.

### *(c) Examination System*

Marks obtained in various examinations are captured and stored in the examination system. Some activities and behavioral subjects have grades rather than marks. These grades along with the Attendance date have been also inputted to the system. Soon the attendance data will be imported from the Student Attendance System. The system generated grade cards are sent to parents. Besides this, report cards of section toppers (first three) and class toppers (first three) are generated and displayed on the notice boards for the benefit of the students. The system has eight years of data in its archives. This is used for verification when students seek admission to foreign institutions.

Subject wise, teacher wise, and section wise comparative reports also can be generated. Performance report of a teacher for a subject over a period of three to five years can also be generated to evaluate the growth of a teacher. Besides, performance evaluation report containing reports of students who score above 90 percent, between 70–90 percent (both the numbers and percentage) can also be generated. The database of the system provides a good opportunity for data mining to look at different patterns in students' and teachers' performance.

### *(d) Timetable Management System*

Parameters like teachers' names, number of periods and subjects taken by teachers are fed into the system. Constraints like block periods (two periods together), lab teachers not to



be given theory classes, two computer teachers in the computer practical, etc., are also input into the system. Thus, a timetable is generated for each section and teacher. The system is still not very perfect and requires manual intervention in case of clashes (e.g., same teacher in two classes at the same time or two subjects for one section at the same time). Similarly, a comprehensive timetable for the school is prepared manually.

Handling substitution for teachers on leave is also part of this system. It allots substitution classes to teachers who have taken least substitution classes. A monthly list of substitution classes taken by various teachers can be generated. The system is still not able to handle constraints such as substituting a teacher from the same discipline.

#### *(e) Leave Record System*

It is an independent system and not part of the payroll system. A teacher is allowed three kinds of leaves: EL (Earned Leave), CL (Casual leave), and ML (Medical leave). When a teacher wants to obtain leave he/she has to fill in an application form and mention the kind of leave he/she intends to take. The person in charge of this system then fills in the kind and amount of leave still due for the applicant. After the Principal sanctions the leave, the person in charge enters the kind and number of leave requested by the applicant into the leave record system. This system can generate the leave status of all employees anytime. However, the leave encashment procedure is done manually.

#### *(f) Payroll System*

It is a comprehensive software and performs all functions like any commercially available software. Though, the school has no system of giving loans, the software can handle loans if necessary. It calculates income tax to be paid by each staff member and generates Form 16A. It also takes care of arrear.

#### *(g) Staff Performance Monitoring System*

Tasks given to each individual staff member are entered into the system and monitored. This system is handled only by the Principal. Monthly report of all tasks allotted, teacher wise tasks allotted, and date wise task allotted is generated. When a task is given, principal enters the teacher's name, task given, and expected finish date and when the task is completed, the actual finish date is entered against the task.

#### *(h) Library Management System*

The school library has over 12,000 books. The database for the books is divided into five or six small data files with reference to accession number in order to enhance the access speed.

Each student is allowed to take two books at a time. The system takes care of issue, receipt, fine (if any), and searching by category of topic/author/accession number. Accession number is entered manually though the system has a provision to generate accession number. This is because, the accession number is generated subject wise and not bill wise. Reports such as overdue books (class wise/section wise/alphabetically with respect to a student/accession number) and complete accession registers (author/subject/accession number) are generated.

*(i) Allocation of Streams System*

This system takes total percentage of marks, average of percentage in mathematics and science, and preference of the student as inputs and prepares a stream allotment chart for the students. It takes into consideration the constraints like number of seats available in each section. It also generates various statistics, like how many opt for what, and how many are allotted, and the subject they want, etc.

*(j) Student Attendance System*

After noting who are absent on a particular day, each class teacher enters that data for a particular section and day into this system. The system then generates monthly attendance report. It also calculates shortfalls for each student and generates a report accordingly. This system has been made part of the lab network as each class teacher has to enter the data as soon as the classes are over. Office computer network does not have that many workstations available at a time.

*(k) Staff Attendance System*

This system was bought from COMPRODEX and implemented in 1997. It has the capability to accept input up to four card readers located up to 300 feet from the central computer. All staff members are issued swipe/ID cards with a laser-printed barcode coded with a unique employee number. At the time of entry and exit, a staff member has to swipe his/her ID card. The time of entry and exit is recorded by the system. A front end based FoxPro program gives access to a supervisor to generate daily/monthly attendance sheets as well as the facility for marking off school holidays, leaves, etc. The card readers have a large internal memory and battery backup too in case of power failure.

*(l) Accounting System*

The school uses Tally for its accounting operation. This system was bought in 1999.



## What Different Stakeholders Say?

*Naveen Mandhana, HOD, Computer Science Department*

'We plan to establish a question bank which can be used to generate question papers. Each question will have parameters like chapter, weightage, etc., that can help in question paper generation.

Total work load of office staff has been reduced significantly because of fee collection, student information system, and progress card. Attendance and progress card systems also help teachers; it makes their tasks easier. In two-third of the earlier time taken, the collection transactions have doubled by using fee collection system. Security is a major concern in the present system. There are two aspects with respect to teachers developing the software: (1) it develops the programming skills of the teachers (2) it adds to the workload of the teachers.

Higher cost and unsuitability are the two reasons for opting for in-house software development. For example, the school had evaluated some 15 odd timetable software from various vendors, but still it could not find a suitable one. On the other hand, the in-house developed timetable software handles most of the school requirements.'

*E. V. Ajai Simha*

'I started applications of computer in school life as well as software development as a hobby. As people started feeling the advantages, they created a demand for more software and machines. However in some cases, initial resistance existed towards computerization. I thank the school administration for their support in providing equipment and opportunity to pursue the matter further. Very quickly the work expanded and it was no longer possible or desirable as an individual effort which led to the creation of the present team of software developers.'

*Abhilash Sharma, Teacher, Computer Science Department (working since 1997)*

'By developing software, I could learn new things. No doubt extra time was required, still a level of satisfaction was there. I got cooperation from all the staff members. Time was always a constraint. I prefer our own software as we could modify them as and when necessary. Also, it is as per our needs. Ready made software does not suit our requirements, e.g., timetable software. Software for student activities is being planned that can be used by the Dean (Student Welfare). It will record activities and performance of each house.'

*Preeti Saxena, Teacher, Computer Science*

'We need to move from the old platform to a new one. We update ourselves through online help. We also went through training on VB conducted by Tata InfoTech. Now, we want to develop a software which can convert numbers to grades and can automate teachers' diary.'

*Ashis Bhargava, PA to the Principal*

'Need based module wise development was done. Gradually, it is being integrated and it is also slowly being updated with inputs from all stakeholders. Timetable system is not yet fully complete. We are planning to go for Windows based Management Information System and we have already started converting old systems into Visual FoxPro platform. Student profiling system will be developed soon and similar system for staff is also in the pipeline. Security part has to be taken care of, as unauthorized persons may make changes that can create problems. The challenge is to generate several analyses as required by the Principal. Many times, the database may not be designed for the needed analyses. People fail to understand this—they think if it is a computer it must be done. Users appreciate getting things done through computers, e.g., Rajesh in fee collection system finds it easy. Vinod Agrawal after initial training is happy with using staff leave record system.'

*Subhranshu Gaur and Mukul Gupta, (Students XII A3)*

'We get complete information about our grade card in comparison to other schools and that too all the information is there in one single page (not three folds, etc.). If any student wants any book and is not getting it, he/she can go to the librarian who can use the Library System to locate it. In attendance system, errors are reduced and innocent students are not bashed. In fee collection system, less time is spent with respect to the experience in the earlier school (of Mukul).'

*Rajesh Gupta, Accounts Department*

'I am using fee collection system since 1996. It saves time and I am able to reconcile accounts easily. It gets slow if more than two/three persons are using the system. It takes 30 seconds to complete a transaction. It can generate defaulter list/daily collection list easily. In a way, the system takes care of all my requirements. Though I did not have computer background, it took 15 minutes to learn the system.'

*Vinod Agarwal, Office Superintendent*

'I use leave record system and have been using this system for the past two years. It takes less time. Usually I spend 10 minutes a day on this system. I can generate leave status report between a range of dates. It can be linked with the accounting system.'

*Ritu Sareen, Teacher, Computer Science Department*

'Teachers Leave Information System in Visual basic was my first software which was developed as a token of gratitude towards the school authorities who were very considerate in allowing me to go for further studies. It was also to show that I can use knowledge gained for the betterment of the school.'



The student's Attendance software was developed in Visual FoxPro (it took two months) in order to incorporate it with the main stream, as was required by the school authorities. It has provided me a platform to develop and test my skills further as the software was to work on the network providing access to the 62 users simultaneously. I had to overcome the challenges like maintaining and providing two levels of security of the database (one at the network level and the other at the application level). I took help from class teachers and the existing register to develop this system. Recognition has been my greatest reward.'

*Madhu Soni, Teacher, Social Studies Department*

'I am a class teacher of class VII. I did not find any difficulty is using computer. Here you need not erase and write again unlike in a paper register. It is fast also. Using computers means being fast, efficient and being oriented to the latest technology. One day training was sufficient to learn the system. It takes two minutes to fill the data.'

*R. C. Boghel, Vice-Principal*

'Students are recognized by their exam roll number. As soon as a parent comes to the reception, we find about the concerned student through the student information database. This helps us to handle the parent in a better way. Parents are also impressed to find that management knows so much about their wards. We even have photos of the students in the database. In the manual system it used to take a lot of time to find information about a student. There used to be a lot of files. We still maintain some files as backup. Teachers enjoy developing software as they want to do something new. There is also some incentive in terms of recognition. We even give some extra increments for doing extra work. For us, work is the main criteria.

We are planning to develop a question bank. All teachers are computer trained. Question bank can help students do well in the IIT entrance test. We don't have clerks and we do everything by ourselves on computers. I did not know computers earlier and learnt it from our own computer teachers. I now use the student database quite a bit.'

## Observation

Most of the teachers involved in software development spent more than the required number of hours in the school as they spend the extra time in developing software systems. When asked about the reward for these efforts, they were happy about the recognition they received.

## Leadership

As has been said earlier and the *raison d'être* of this book is to assist the school principal who has to be multifaceted in an attempt to make the school IT-Savvy. Several leadership roles have to be demonstrated in order to ensure effective IT deployment in the school. Some of these roles are:

- Define a vision for teaching and learning, and explain where technology fits within that vision. The IT vision developed by Mother's International School, New Delhi, is included in Box 9.1 as an illustration.
- Identify the target group that needs to be reached through the use of technology.
- Define appropriate programs for the use of technology-based delivery.
- Create a champion group and motivate them to help novice technology users.
- Identify training needs and areas of support outside/inside the school. Determine support staff for technology-based teaching that needs to be provided in-house.
- Ensure that innovation and the skilled use of technology for teaching is properly recognized and rewarded.
- Decide on key areas of investment and resource allocation for technology-based teaching.
- Keep abreast of best practices in other schools and help one's own school to emulate the same (Guan 2001).
- Principals must constantly keep track of new and emerging technologies and how they can affect teaching and learning processes in the school.

### 9.1 Principal as an Information Strategist for Schools

Out of the roles mentioned above, the most important one that a principal plays is that of an information strategist. A leader has been traditionally charged with the role of being a designer (Senge 1990). It is within the purview of this that a principal has to realize that he/she has the sole responsibility of designing the 'Information Strategy' for the school. The term refers to the document that outlines plans and policies of the organization for present and future use of IT and related issues (Latham 1998). To make effective use of ICT, schools need to formulate long term strategy.



There are three levels of information strategy—Information System (IS) Strategy, Information Technology (IT) Strategy, and Information Management (IM) Strategy (Earl 1989). IS strategy focuses on deriving strategic advantages for the organization. IT strategy suggests how technology should be used (what, from which vendors). IM strategy specifies the link between IT specialist and users. It defines management structures and processes that facilitate the use of IT. This whole concept may be explained with the help of an example. If the use of IT in curriculum is seen as being beneficial to students (an example of IS strategy), IT strategy will dictate what technology platforms to use and IM strategy will help in deciding what kind of training programs to organize and schedule. Schools need to formulate a comprehensive strategy to derive maximum benefits from the resources they put in to procure ICT.

Principals need to develop a holistic approach for IS/IT strategy to be able to realize the potential of ICT. This approach should promote IT across the whole curriculum, integrate the management of ICT resources in the curriculum, involve the entire staff, and recognize the need for long term planning (Latham 1998).

Though devising strategies can be time consuming and costly to begin with, in the long run it saves both time and cost. To gain greater acceptance among staff, the strategy building process must be bottom-up (from lower staff to principal). The strategy should continue to change in response to the environment. While developing a technology plan, it is important to design it with the students in mind, developing student expectancies, and aligning student benchmarks (Reksten 2000). Bates (2000) argues that ‘use of technology should be embedded within a wider strategy for teaching and learning.’

Some of the fundamental decisions that a principal needs to take while designing the ICT strategy in the school are:

- Rethink educational processes and structures.
- Align technology with educational challenges, goals, and instructional strategies.
- Invest in professional development.
- Invest in rigorous evaluations to decide effectiveness of technologies (Bailey 2003).

A sample ICT strategy of Mother's International School, New Delhi has been included for reference in Appendix-B.

## 9.2 Common Barriers to ICT in Institutions

The ICT strategy in schools should recognize the barriers it has to overcome. Some factors that may act as barriers in the successful implementation of ICT in schools are:

- Lack of prior knowledge about computers leads to nursing misconceptions about computers and their use. Such beliefs stop people from embracing IT easily.

- Compartmentalization of the computer science department and lab has created alienation within the school. Computers are not seen as an integral part of the school. The staff in computer science department also work towards retaining their special position.
- Computers are allocated to the staff based on seniority rather than requirement. This leads to power plays and inequitable allocation of resources.
- Introduction of IT creates additional responsibility for many, which is not matched with power. Thus, people concerned with the implementation of IT fail because of lack of control over resources (Somekh et al. 1997).

The principals must understand these potential roadblocks and try to overcome them with his/her understanding of designing and implementing IT in schools.

#### Box 9.1

##### Vision statement for IT in school

###### **Mother's International School, New Delhi**

As an educational institution, we recognize the role of Information Technology in the educational process. Our endeavor will be:

- To optimize the use of technology as an effective and necessary tool for a lifelong learning process.
- To use it as a catalyst that encourages students to explore and experience the broader areas of interest and to think more creatively, independently, and critically than before.
- To provide students access to learning and information anytime, anywhere, and to bring together all members of educational enterprise into a connected learning community.
- To make technology an integral part of the instructional process so as to assist the teacher in creating a learning environment that is interactive, collaborative, multidisciplinary, and exploratory.
- To enable teachers to discuss curricular issues and practice not only with colleagues in their own school but also with teachers across the globe.
- To help teachers to receive, read, access, guide, discuss, and respond to student assignments on-line.

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## Collaboration

### 10.1 Collaboration: A Strategic Action

Successful implementation of IT in schools may call for collaboration not only with technology providers but also with other schools. Schools can learn the best practices with respect to the use of technology from other schools which can be used to facilitate collaboration in other areas. Collaboration has been seen as the key to success in today's business world (Arzoumanian 2001). By networking with each other and designing joint programs, schools can learn a lot from each other. Keane (2002) emphasizes that teachers from various schools can benefit by collaborating with each other. Bates (2000) argues that 'partnership and collaboration are strategies for sharing the costs and leveraging the benefits of technology-based teaching.' Silva and Breuleux (1994) suggest that networks and Internet should be used to promote collaborative learning. CyberOlympics project of Cunningham et al. (1998) showed that if the context is right, effective collaboration takes place. Guan (2001) suggests that teachers must swap software, knowhow, and their experiences, with other teachers. This will help improve the usage of software thereby creating a large pool of educationally satisfactory ones.

Software tools like groupware can facilitate students and teachers to work with each other within the school and also with other schools. These schools can be from other parts of the country and/or from outside the country. Collaborative work fosters teamwork skills and the ability to work in a virtual environment.

To understand the power of collaboration, let's first look at some interesting examples of collaboration and then the software tools that can promote collaboration. This will help principals to appreciate the power of joint action and the tools that are required to promote it.

### 10.2 Products of Collaboration

Perhaps the most celebrated example of collaboration is Open Source Software (OSS) movement which has already been discussed in Chapter 3. It may be noted that this movement started with the idea that software is an intellectual product and it should be available for



all to use, modify, and redistribute. Richard Stallman gave a push to this movement by setting up Free Software Foundation, setting standards for OSS and spreading information about it worldwide. The development process of OSS is collaborative. Before development of a particular software, a group of people become the key group, define specifications of the software, and publish it on the Net with an invitation to programmers all over the world to develop any part of it. Programmers who are passionate about the value of freedom write software modules in their free time and submit it to the group for evaluation to string all the modules together. The key group after putting all modules together publishes it on the Net for people to download, use, and report bugs in the software. The freelancers also provide rectifications which are incorporated and the revised version is again made available on the Net to download. The software goes through several rounds of iteration and finally emerges more stable and efficient in comparison to the proprietary software. It is true that there are many OSS which may not have been developed using the collaborative method, with individuals or organizations wanting to share their products and publishing them as OSS.

The process and nature of collaboration of the intellectual property of OSS has enthused people from other fields to come up with similar products. Some of them are open access journals, wikipedia, open courseware, wikitext, and open music, etc. Though all of them are not collaborative products in the way wikipedia and wikitext are, the emphasis is on sharing. Hepburn (2004) argues that open source development models can be used to develop the concept of school as educational commons. A 'commons' refers to 'a wide array of creations of nature and society that we inherit freely, share and hold in trust for future generations' (Bollier 2003). The market does not allow many to have access to schools and future designers of social systems will need to tackle this anomaly.

### 10.2.1 Open Access Journals

Open access journals contain scientific articles available online free of cost to readers and libraries. Paper based journals are costly and not available everywhere. Borrowing ideas from open source movements, the proponents of open access journals believe that knowledge should be available free and to everybody, so that society at large and particularly researchers, can benefit from it.

Open access journals follow the same procedure as paper based journals, which means all articles are reviewed by peers and the same professional quality is maintained (Suber 2002). The cost of managing these journals are taken care of either by payment from authors or from grants and supports from other institutions and foundations. BioMed Central (<http://www.biomedcentral.com>) is one of the most well known publishers of open access journals. It makes money through its auxiliary service, faculty of 1000, which provide recommendations regarding new work in biomedical specialization (<http://www.facultyof1000.com>).

## 10.2.2 Wikipedia

Wikipedia (<http://www.en.wikipedia.org>) is another wonderful example of collaboration. A Wiki or wiki (pronounced 'wicky' or 'weekee') is a Website (or other hypertext document collection) that allows a user to add content, as in an Internet forum, and allows others to edit it. Wiki comes from the Hawaiian term for 'quick' or 'super-fast.' Ward Cunningham is the inventor of Wikiwiki concept. Wiki servers allow users to write in simple 'wikitext' and it creates the necessary html pages from that. Thus, users need not to know html codes. Allowing everyday users to edit, the Website encourages democratic use of the Web. Each wiki page contains links to other pages. Some of the major wiki engines are MediaWiki, MoinMoin, UseModWiki, and TWiki.

Using Wiki facility, Wikipedia has emerged as the largest encyclopedia today. In less than half a decade it has 22 million entries extending across 200 languages. There are 600,000 articles in the English language volume alone. Contributors to Wikipedia are people who not only use this site for information, but also contribute in developing the encyclopedia. There are about 3,800 hardcore users making more than 100 edits a month, and another 18,000 who make at least five entries a month. According to Jimmy Wales, founder of Wikipedia, he is building 'a world in which every person on the planet is given free access to the sum of all human knowledge.' The success of Wikipedia can be ascertained from the fact that Microsoft's Encarta has started adopting wiki-style open editing for its for-profit encyclopedia.

Wales started Wikipedia in January 2001, as an offshoot to a failed commercial encyclopedia, Nupedia. Wikimedia Foundation manages the Wikipedia project. It operates on an annual budget of \$800,000 (£450,000) and perhaps most surprisingly, with a staff of just one person. The Wikimedia Foundation is funded by contributions from charitable foundations and its reading public. Apart from encyclopedia, the foundation also offers a dictionary, a taxonomy of the species, and a news service. All operate under the same concept of openness and public cooperation without the need of financial incentive.

Wikimedia Foundation has started several new projects using the same collaborative methods. Wikitionary ([http://www.en.wikitionary.org/wiki/Main\\_Page](http://www.en.wikitionary.org/wiki/Main_Page)) is a free multilingual dictionary in several languages with definitions, etymologies, pronunciations, quotations, and synonyms. The English version was started in December 2002 and has over 98,000 entries as on October 2005. Wikiquote ([http://www.en.wikiquote.org/wiki/Main\\_Page](http://www.en.wikiquote.org/wiki/Main_Page)) is a free online compendium of quotations in every language, with sources (where known), translations of non-English quotes, and links to Wikipedia for further information. English version of Wikiquote has 4,670 pages so far with thousands of quotations and proverbs. Wikispecies ([http://www.species.wikipedia.org/wiki/Main\\_Page](http://www.species.wikipedia.org/wiki/Main_Page)) is an open, free directory of species with information on animals, plants, fungi, bacteria, and all other forms of life. Under Wikibooks ([http://www.en.wikibooks.org/wiki/Main\\_Page](http://www.en.wikibooks.org/wiki/Main_Page)), 10,000 book 'modules' are being collaboratively written. Soon, they will be published under the Foundation's



banner with assistance from an 'on demand' publisher. This may signal a whole new kind of book publishing. In Wikinews ([http://www/en.wikinews.org/wiki/Main\\_Page](http://www/en.wikinews.org/wiki/Main_Page)), everyone is allowed to post news that they know of.

Wikimedia Foundation also has plans to host a range of new services—an online atlas charted by members of the public, a repository of classical music performed by student orchestras, a file format to rival the mighty MP3, an online curriculum stretching from kindergarten to university, and an archive of images with paintings by the old masters.

### 10.2.3 Open Courseware

Following the spirit of open source software movement, in 2003, MIT decided to make all its courseware available through its Website (<http://www.ocw.mit.edu/index.html>). The idea was to share these materials with other colleges and others who want to use the same. This is in keeping with MIT's institutional mission to advance knowledge and education, and serve the world. These are known as open courseware. At present, there are about 1,100 courseware. MIT Website also allows faculty members of other colleges to publish their materials on its site. Now a number of universities have followed MIT and are coming up with their own open courseware.

There is another Website (<http://www.freecurricula.org>) which serves as a focal point for the development and sharing of textbooks, instructor guides, and other educational materials. These materials, called free curricula, are released at no cost into the public domain or under an 'open source' style license which allows anyone to make and distribute copies without having to pay, and to modify the curricula as long as those modifications are released under the same terms. The Website provides online tools for people to work together to create textbooks, instructor guides, and other materials for the subjects in which they have expertise.

## 10.3 Tools of Collaboration

There are several IT tools that can facilitate collaboration. A few of them are discussed in the section below.

### 10.3.1 Groupware

Groupware is a kind of software that facilitates interactions between people located in various places. For example, if Ford Company wants to design a car using people located in its various offices and factories, it can make use of a software called the groupware to facilitate interaction between the remotely located members of the design group. The group members can work

on the same file or object and can view changes made by each other. The term groupware was defined for the first time by Johnson Lenz to refer to computer systems plus social group processes (Ells et al. 1991). A groupware may have a meeting software that can track when group members can meet, depending on the others' schedules. It also facilitates computer conferencing and decision making processes. Lotus Note is a popular software of this kind.

### 10.3.2 E-group

E-group is a simple tool by which mails are sent to a group of people through a common ID. Earlier, one had to subscribe to Listserv software to be part of a mailing group. Now the e-group facility of Yahoo and Google have become more popular. E-groups also extend facilities to share photos, links, addresses, and even conduct polling. One can login to <http://www.yahogroups.com> and create a new group. But for this, one has to have a Yahoo ID. The group can then be placed in one of the categories mentioned by Yahoo groups. This makes a listing in the Yahoo Group directory for everybody to search and find the group. The owner of the group can then either invite people to subscribe to the group or add the e-mail ID and name of the group members directly. By having one single ID, people can send information or opinion on a topic to all the group members and can initiate a discussion. Yahoo stores all the messages which can be retrieved. A group can be a closed one or an open one. In the former, the owner or another moderator has to approve the membership. Similarly messages can be moderated or unmoderated. In case of former, all messages have to be approved by the moderator. This is to avoid unwanted mails to the group.

Schools can use e-groups very effectively. Though it is a simple tool, yet its use can be varied. There can be an e-group for teachers, for parents, and even for students of different classes. Information sharing can be done using e-groups. Teachers can use e-groups to discuss issues regarding the school and then take a decision. They can upload links and assignment files that students need to use. The principal can run a poll on some issues, for example, on whether to use firecrackers during Diwali and seek the opinion of students.

### 10.3.3 Blogs and Edublogs

Blog stands for web-log and is used to write one's own thoughts and ideas, which are available for other webloggers to read, reflect and comment on. It is a kind of a personal diary on the web. Weblogs are fully functional Websites with built-in tools. They provide writing spaces, characterized by their ability to handle text, images, and other media components such as audio files. Each story posted has an associated discussion thread enabling invited



members to contribute their comments and reflections. The main features of a weblog are (Ref: <http://www.ecolenet.nl/best/edublogs.htm>):

- Ease of use: Author can publish without the knowledge of coding.
- No need to install any server software.
- Extensive user control on how the weblog looks and operates.
- Edited content is instantly updated and available for others to see.
- Weblogs can be linked and navigated.

Weblogs are available for free. The blogging software helps in deciding the title, public status of the article, and other features. It also maintains the date of the articles. Blog is becoming a powerful tool for sharing ideas and thoughts. There are more than 4.1 million blogs on blog-hosting sites such as LiveJournal and BlogCity. They are proving to be a successful tool in providing information during earthquakes, tsunami, and other natural calamities.

Depending on the subject covered, blogs are also named differently. For example, blawg is related to legal matters, bleg is used to beg for help and money, warblog tackles war, and a photog contains pictures specially candid shots of people in public places (Mcfedries 2003). Edublogs are used for educational purposes. A community of learners can share their thoughts and ideas on a particular topic. A blog used by a teacher can contain following elements (Ref: <http://www.ecolenet.nl/best/edublogs.htm>):

- Links to websites as resources
- Observations on learning content
- Discussion forums
- Learning resources
- Syllabus

Teachers can also take a look at the blogs maintained by students to understand their thinking patterns and depth of understanding on certain issues. In comparison to articles of students posted on websites, blogs work more effectively as there is ownership and it is more dynamic, with students adding to their blogs on a continuous basis. Blogs can also be cross-referenced between a community of learners.

Schoolblogs.com provides a feature-rich solution for the creation of Websites, free storage of media components such as images and audio files as well as collaborative editing using the threaded discussions assigned to each post. Other free providers include the following:

- Blogger.com provides a free, automated weblog publishing tool. You may join blog\*Spot which is a free weblog hosting service integrated with the blogger tool.
- Conversant (free-conversant.com) provides free content management system. Unlike Blogger, there are no advertisements inserted into your free site.

- GrokSoup.com provides hosting, content management tools, templating, and XML based content sharing. All editing is browser-based and the service is free.
- Pitas.com provides free hosting for weblogs and news sites. Pita sites are easy to update using a simple web interface.

### 10.3.4 Social and Business Networks

Presently, there are several Websites which promote social and business network. Some of the prominent ones are Ryze (<http://www.ryze.com>), Hi5 (<http://www.hi5.com>), and LinkedIn (<http://www.linkedin.com>). These sites allow members to post their profiles after which they can visit profiles of other members and can sign the guest book or send a private mail. Once somebody is accepted as a friend, he/she becomes part of the network of that person. The software shows how another member is linked to a person through friends' friend. Anyone can send an invitation to another member to become part of his/her network. These networks are proving to be a good medium to reach persons of similar interest and enhance one's own network.

### 10.3.5 Some Sites Promoting Collaboration

There are also several Websites that promote collaboration between schools, teachers, and students from various parts of the world. One of them is <http://www.think.com> promoted by Oracle Education Foundation. This site allows students and teachers to register first and then use websites and interactive tools provided by the site to publish their ideas, collaborate on projects, make friends, and build knowledge.

Establishing collaboration with various stakeholders (parents, society, alumni, government, and industries) and other schools is a major responsibility of school principals. They can use simple tools like e-mails and e-groups for relationship building and networking. For example, a school can use e-groups to keep parents informed about what's happening in the school and also to solicit help and suggestion from them. These can also be used to keep in touch with the alumni.

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## 11.2.3 Questionable Content

Since anybody can put any material online, in the case of books where the copyright of Internet pages is both a powerful tool and also a liability, the threat of piracy is a real one. The problem associated with the extended use and access to Internet is not that it is not on the Web but that it is not on the Web. The problem is that the Internet is not a controlled environment. Students can find information on the Internet that is questionable in nature and content. This is a real problem for educators and parents. The Internet is a double-edged sword. It is a powerful tool for learning and research, but it is also a source of misinformation and questionable content. The problem is not that the Internet is not on the Web but that it is not on the Web. The problem is that the Internet is not a controlled environment. Students can find information on the Internet that is questionable in nature and content. This is a real problem for educators and parents.

## 11.2.4 Pornographic Sites

Some students may get hooked to the Internet and spend excessive hours in front of the computer terminal. This may happen due to the fact that they may be exposed to and become addicted to the Internet. The problem is not that the Internet is not on the Web but that it is not on the Web. The problem is that the Internet is not a controlled environment. Students can find information on the Internet that is questionable in nature and content. This is a real problem for educators and parents.

## **Students and Computers: Miscellaneous Issues**

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Earlier chapters have already taken up issues related to the use and implementation of IT in schools. However, there are some more issues related to students and their relationship with IT that principals need to know. This chapter focuses some of those issues.

### **11.1 Individual Differences in Exposure to Use of Computers among Students**

Students are not equal in their capabilities and exposure to computers. While some are keen to use computers for playing games rather than seeing it as a tool for learning, others may have more state-of-the-art computers at home and may get frustrated with not so sophisticated computers in school. Some students may dominate the use of computers in school and some may take longer to become comfortable in using them (Dawes 1999). These individual differences need to be kept in mind by the principal to cater to the special needs of students to enable all of them to gain from the use of computers.

The principal and the computer teachers need to be sensitive to such issues and plan for contingencies arising out of the above mentioned issues.

### **11.2 Negative Impact of Internet**

The sheer enormity of Internet makes it both a powerful tool and also a Pandora's box of problems. Let us look at some of the problems associated with the extended use and access to Internet.

#### **11.2.1 Internet Addiction**

Some students may get hooked to the Internet and spend excessive hours in front of the computer terminal. This may happen due to the loneliness they may experience and because of the pleasure they draw from contacting others, gathering information, and being



anonymous. This addiction may influence performance in studies negatively and may hamper daily routine like sleeping, eating, etc. Excessive use may also lead to greater social isolation. To begin with, parents may be proud of the ability of their child in using the Net, however, soon its unchecked use could lead to worrying problems (Chou and Hsiao 2000). Schools therefore, need to develop the wherewithal to counsel these students.

### 11.2.2 Copying and Copyright

It is not uncommon to find students collect information from various sources and put them together to submit the required assignment or project report. Teachers have reported instances of students copying complete sections from encyclopedias such as MS Encarta without even making an effort to paraphrase or summarize. They do not use information from various sources to come up with their own arguments and understanding. This defeats the basic purpose of giving home assignments or projects. If such instances happen often, then teachers need to rethink their assignments and projects. Teachers therefore, must be sensitized on the need to give assignments that require analysis of information rather than simple gathering of facts. There are now some software which can detect whether a student has copied extensively from another source. Plagiarism-detection software (such as iParadigm's Turnitin) can make a digital fingerprint of a document and compare it against the material on the Net and other electronic database. This is being used by about 2,500 high schools and colleges in the USA. This kind of software may deter students to copy from other sources.

Both teachers and students must appreciate the implications of copyright while using resources available in the Net. In fact, Bates (2000) argues that all teachers should be given some awareness training on copyright laws.

### 11.2.3 Questionable Content

Since anybody can put any material easily on the Net, unlike in the case of books where there is some selection and filtering that takes place in the process of editing and publication, the quality of the material available online is very uneven and questionable. Thus, one should not accept all that is put on the Web without evaluation. Students need to be trained to filter and evaluate information.

### 11.2.4 Pornographic Sites

Many unscrupulous people have set up pornographic sites that offer free samples of pornographic pictures and videos. In fact, some even manage to send e-mails that have some

introductory pictures and links to the sites which may harm the innocent minds of students. To stop this menace, schools can install blocking software that block objectionable sites and also have an established Net policy. Search engines like Google and Yahoo have the capabilities to avoid unwanted sites while performing a search. These search engines can be configured accordingly. Even the ISP can limit access to Internet pages that have been previously vetted as improper.

An article of *eSchool News* (21 July 2003) reports that Internet has also increased gambling among school students as there are many gambling sites available on the Net. The principals need to be aware of such unintentional consequences and add them to the list of aberrations in student behavior.

### 11.2.5 Hacking

Some students are very good with computers and along with their ability to surf the Net, they also learn ways of connecting to other people's computers. This is then used to get some files from or create problems in those computers. In plain and simple terms, this amounts to stealing and harassing others. The very concept of gaining access to restricted areas gives thrill to some students. This behavior is known as hacking and is illegal and punishable under law. Schools must make students aware of the consequences of hacking and provide enough challenging assignments to students so that they don't resort to hacking. An *eSchool News* online article titled, 'Student Hackers are a Blessing and a Curse to Schools' urge that only by making students aware one can minimize this problem.

### 11.2.6 Privacy and Safety

Many schools put up photographs, names, and e-mail IDs of their students who have achieved laurels in games or academics, etc., on their school Websites. This display of information sometimes creates problems. Hackers, cyber loafers, harassers can use the information to contact those kids and mislead them. There have been instances where adults have pretended to be kids and contacted other kids through online chats and e-mails and later they have convinced the child to meet them in person. The results of these meetings have been fatal or disturbing to those kids. The principals, teachers, and students need to be aware of these dangers and discussions on these topics must be made part of school activities. The Net Policy given in Box 6.6 highlights the do's and don'ts of using Net (See Seven Smart Rules of Internet Safety in Chapter 6).



### 11.3 Should Laptops/Notebooks be Given to Students?

Some schools in Australia have experimented with giving notebook computers to their students. A longitudinal study by Newhouse and Rennie (2001) showed that the use of portable computers in a school in western Australia did not bring in the expected increase in engagement and performance. Still many schools are experimenting with notebook computers. It is expected that students will use the notebook to take notes, do home work, etc. Indian schools must however, keep an eye on this and see if its use can be beneficial. It must be remembered that notebooks are very expensive and not as sturdy as desktop computers. Hand held computers and tablet PCs are emerging as substitutes for laptop computers in schools.

### 11.4 Gender Issues

According to Kirkpatrick and Cuban (2000), girls do not spend as much time as boys spend on computers, hence they might be perceived as less competent. But, the truth is that there have been some outstanding women achievers in the field of IT. Lady Lovelace is credited to be the first programmer and Ms Hopper was a remarkable programmer in IBM. Carly Florina managed Hewlett Packard, one of the top computer companies of the world. Principals must be aware that given an equal opportunity, girl students will do well in IT and at the school level they must be encouraged so that any perceived difference due to stereotyping is minimized.

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## **Emerging Concepts and Technologies**

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This chapter is a primer to the many emerging technologies that are available in the market. Technologies are either mainly in the form of hardware or software. Besides technologies, several new concepts like knowledge management and smart school also have emerged. This section lists each of these categories. The principal may find it useful to know what these are and their potential for use in the school.

### **12.1 Technology**

#### **12.1.1 Hardware**

Some of the emerging technologies in the field of hardware are discussed below.

##### **12.1.1.1 Handheld Computer (<http://www.techknowlogia.com>, Oct-Dec 2002)**

PDAs (Personal Digital Assistant) are handheld computers, 3 × 3 inches in size with software for address book, calculator, memo pad, etc. It can be used by students to collect and analyze data by connecting various probes to it. There is also an instructional management software that can be loaded on to the PDAs to help teachers to keep track of students' progress. Some schools also use these devices for word processing and Internet browsing. In some schools in the USA, teachers use handheld computers to quiz students, grade tests, and report scores.

According to Cathleen Norris, Professor of Technology and Cognition at the University of North Texas and co-president of International Society for Technology in Education, the third generation handheld computers will be specially designed for schools and every child will have one like having a pencil. Microsoft views Tablet PC as the future device for schools complemented by handheld computers.

##### **12.1.1.2 Simputer—Low Cost Portable Alternative to PCs**

A few scientists from Indian Institute of Science, in collaboration with a private company in Bangalore, have designed a handheld computer that is being publicized as the instrument



of IT revolution in the country. This is known as Simputer (Simple, Inexpensive, Multilingual computer). As a Simputer is expected to cost less than Rs 10,000 and loaded with Linux based free software, schools may want to experiment using it in their teaching and learning processes. PicoPeta's experiment with simputers in some schools in Chhattisgarh has been quite encouraging (<http://www.picopeta.com>).

#### 12.1.1.3 Tablets

Tablets are a  $6 \times 9$  inches notepad with a pen and built-in radio frequency transmitter. One can write on this and the handwritten text can then be sent to a computer via a cable. The text can be either stored as handwritten text or converted into normal text by a conversion-software. This device can be used to enable handwriting practice and also teach computers to very young children. The teacher can write and project her handwriting on a big screen as a model for children. Individuals who are uncomfortable with the mouse and keyboards can use this device too. The tablet can also be used as a drawing notebook by students (<http://www.techknowlogia.org>).

#### 12.1.1.4 Electronic Whiteboards (<http://www.techknowlogia.org>)

One can save, print, e-mail or fax whatever is written on an electronic whiteboard. They use pressure sensitive technology known as touch screen or laser technology. Combined with special software, they can be used in teleconferencing, where multiple users can work on the same document simultaneously. The biggest benefit of this board is archiving; notes from earlier meetings can be retrieved and re-examined. Though cost-wise and utility-wise, this may not be an ideal choice for schools, still some schools in Mumbai have procured these whiteboards and are experimenting with them.

#### 12.1.1.5 Speech Technology

Speech recognition refers to a computer's ability to analyze and understand human voices. There are also several conversion software that can convert human voices to text and vice versa. All these hold the promise of being used effectively in early language development of small children and learning of foreign languages. Schools may start experimenting with this technology if they have the resources.

### 12.1.2 Software

Some of the emerging technologies in the field of software are discussed below.

### 12.1.2.1 Intelligent Tutors (<http://www.techknowlogia.org>, Jan–Mar 2002)

Computer assisted instruction provides text interspersed with multiple-choice problems. But an intelligent tutor is different. It optimizes learning by using three kinds of information: domain expertise, pedagogical theory, and characteristics of the individual learner. So, it not only provides all relevant facts, but it does it in a manner that maximizes learning. While doing so, it only takes into consideration the ability of the learner. So, it is a highly customized tutorial. There are not many intelligent tutorials as both cost and complexities of writing them are high.

### 12.1.2.2 E-Books (<http://www.techknowlogia.org>)

Small handheld computers that can store a few thousand pages and run on battery for few hours are promoting the concept of e-books. E-books can be downloaded from the Net. They reduce the requirement of printing paper books and the whole logistics of storing and transporting them. The cost is reduced and no book will be ever out of print. Authors can also self-publish and upload content to a distribution site. Teachers who compile the course materials by photocopying from different sources can get digital material from the distribution centers and put them together at a lower cost.

A pilot study of iText of Pearson Prentice Hall showed that students engaged themselves more with e-textbook (Branigan 2003). Students liked the immediate feedback, and the availability of supporting materials/clarifications through audio and visual sources. However, e-books do not offer the flexibility of reading at any place as is the case with printed books.

### 12.1.2.3 E-Rater (<http://www.techknowlogia.com>, Jan–Feb 2001)

E-rater is an automated essay scoring technology that uses natural languages processing (NLP) and information retrieval (IR) techniques to assess general qualities of a written piece for syntactic variety, topic content, and organization of ideas. One can try e-rater at <http://www.techknowlogia.com>. This can be used along with the teacher's evaluation to help students write better. Another technology called c-rater or concept-rater can automate the scoring of short-answer content-based responses to questions such as those that appear in a textbook's chapter review section.

### 12.1.2.4 Streaming Video

Streaming video technology allows retrieval and display of image from a remote Website simultaneously. A recent study by United Learning, an educational audio-visual company in 1,400 elementary and middle schools of North Virginia in the US showed that streaming video technology enhanced student achievement by 12.6 percent as compared to traditional teaching methodology (<http://www.eschoolnews.com>).



### 12.1.2.5 Sense of Touch through Internet

Researchers at the University of Buffalo have developed a concept called 'sympathetic haptics' where users can not only see an object but also feel it (Murray 2003). For example, students with futuristic gloves that have pre-stored sensory outputs can feel the actual sense of touch communicated by the instructor through the Net. According to the lead researcher, Kesavadas, this technology can add more reality to online education which is at present primarily based on visuals.

### 12.1.2.6 Digital Library

A digital library keeps books, magazines, and other documents in electronic form. The users of campus intranet can look at the catalog, search for the materials they are looking for, and then either can download them on their own PC or print them using a laser printer. The library can also provide access to other databases so that users can get more information.

## **12.2 Concepts**

### 12.2.1 Net Courses

Net courses break the shackles of time and space. Students who cannot attend schools because of various reasons like illness or being far away can benefit from them. They are also useful for students who are shy and do not respond before a crowd.

#### 12.2.1.1 Characteristics of Net Courses

According to Berman and Tinker (2000) one cannot simply transfer traditional courses to the Internet, but needs to rework in order to accommodate the following characteristics:

- *Asynchronous communication*: Courses should adopt asynchronous communication tools (where both the sender and receiver need not be engaged at the same time as in a telephonic call) like e-mail, conferencing, and news-group.
- *Seminar model*: Here teachers decide the topic and activities and encourage students to interact with each other while monitoring the interactions.
- *Technology-rich instruction*: Teachers must use all resources like digitized images, short audio and video clips, graphics, and conferencing facilities to make the lessons interesting and facilitate interaction among students.
- *Project-based learning*: Students should be given projects where they can collaborate and learn to use various resources available.

## 12.2.2 E-learning

The facility of Internet and intranet enables e-learning that allows learning anytime and anywhere. E-learning is a student-centered learning approach and can complement class room teaching too. In countries like Australia and Canada some virtual schools have already been established, where students need not go to an actual school; they can learn through the Internet at home. In India, companies like classteacher.com and e-gurucol.com are offering Internet-based e-learning modules. Considering that most of our students cannot afford Net connectivity in their homes, schools can rather opt for intranet based e-learning to supplement their class room teaching.

Some of the tools that can facilitate e-learning programs are Blackboard (<http://www.blackboard.com>), IntraLearn (<http://www.intralearn.com>) and WebCT (<http://www.webct.com>). Recently, Massachusetts Institute of Technology has developed a course management software called Caddie.net that can be downloaded by schools free of cost.

If schools opt for e-learning courses and online presentation of examination results and other information, then many factors need to be kept in mind. The Internet option can be used for publishing results, circulars, and other information. However, the same cannot be used for e-learning facilities as it requires them to have Net connectivity at home and thus may be unaffordable for many. Though many homes in metro cities have Net connection, the cost of using Internet for prolonged hours is prohibitive. Also, there will always be students who cannot afford computers and/or the cost of Net connectivity on a continuous basis. The alternate solution is to develop this system on the school's intranet. Once the school has an installed network of Web pages (may be developed) and required software installed in the servers, there is no cost for students to use the facility in their school premises. If some students and parents need to access this facility from outside, an extranet can be built. This way, interests of both the rich and poor students can be taken care of. Also, schools can build in-house expertise to develop and maintain such a system rather than depend on the outside vendors.

## 12.2.3 Virtual School and Smart School

(<http://www.techknowlogia.org>, Apr-Jun 2002)

### *What is a Virtual School?*

According to the US Department of Education, a virtual school is 'an educational organization that offers K-12 course through Internet or Web-based method.' A virtual school can operate under a time frame (with a beginning and an end date for programs) or can be self-paced. A virtual school requires better technology infrastructure that supports two way



communication and storage and retrieval of large volume of text, etc. According to Russel (2001), there are some virtual schools in USA and Canada where students do not need to go to school at all and can get all their schooling through the Net. Doheny-Farina (1996), feel that these kind of schools will increase in future.

### *What is a Smart School?*

According to Maheswari (2002), schools which support learning and thinking skills with programs, infrastructure, tools, teachers, and management-aided information and communication technologies are smart schools. Students learn by asking questions, reading, exploring, day dreaming, formulating and testing hypothesis, communicating what they learn, and by practicing skills. Thus, the emphasis is on 'learning to learn.' Technologies such as computers, Internet, and video conferencing are used for teaching and learning. As smart schools need to support and nurture the individuality of each learner, the assessment mechanism should keep that in mind. Teachers have to play two crucial roles:

- Able to link activities done on the computer to the general education of children.
- Act as facilitators in the process of learning.

The concept of smart schools was initiated by Smart Valley, Inc., USA. National Action Plan for Information Technology of the Indian Government also talks about starting smart schools in India. Smart schools are becoming important as modern workplace is increasingly demanding use of information and communication technology, team efforts, and group collaboration (ibid.).

## 12.2.4 Knowledge Management in Schools

Schools are also learning organizations and they not only need to generate knowledge, but also preserve it for future use. Knowledge should be available in a form that is accessible to all. For example, a teacher might have developed a new way of teaching, and if it is not documented, it will be lost when the teacher resigns or retires. Also, paper documents are less accessible than the digitized form. The process of storing and disseminating knowledge is known as knowledge management and IT has been a prime driver in the same. According to Katz (1999), educational institutions with the most intellectual capital will have a new and powerful source of competitive advantage. Thus, institutions have to adopt knowledge management processes to acquire information and knowledge from both external and internal sources, and disseminate them (Dhillon 2001). Schools may wish to opt for knowledge management in a limited way.

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## CASE STUDY V

### Virtual School Facilities (Delhi Public School, East of Kailash, New Delhi)

Delhi Public School (DPS), East of Kailash, was established in 1974 by the DPS Society. It was the primary wing of DPS, R. K. Puram. It had classes from nursery to V. On completion of class V students automatically moved to middle school section of DPS, R. K. Puram. The student strength of the school in 2003 was 1,500 and it had 80 teachers on its roll.

DPS believed and practised activity-based learning. Information Technology (IT) was introduced in the school to support its basic philosophy of teaching-learning methods.

### IT Infrastructure

The school has two computer labs with 23 and 18 computers each. Both the labs are connected through local area network and the software is loaded both on the server and workstations. Students are taught Excel, Paintbrush, Word, PowerPoint, and Logo, etc. There are two computer teachers. The school has Net connectivity through dial-up mode, but it



plans to have lease line connectivity in the future. Teachers have also developed FoxPro-based student database system. The school uses the CDs available in the market, but has found most of the materials not suitable to its requirement. DPS has a well maintained audio-visual (AV) room with mounted LCD projector, gallery type seats, and proper audio and air conditioning facility.

## Process

In 2001, DPS partnered with classteacher.com (CT) to offer virtual school (VS) facility to its students. It interacted with many vendors who had approached it for virtual school solutions and finally zeroed in on classteacher.com as their products/services were more child friendly. The school set out with the goal of using IT to stimulate and satisfy children's curiosity.

According to Ms Amita Mishra, Headmistress, the rationale behind using virtual school concept was—'One of the focus areas of primary education is to develop curiosity and widen the canvas for students. Students enter at a tender age of four in a primary school. The school should use all tools available to enhance the process of inquiry. Computer should not be used to push standard teaching materials. But if by adding animation the materials can be made more livelier, then they should be exploited as much as possible. The virtual school concept seemed to fit well in this objective and thus we decided to adopt it.'

There was also a practical requirement for adopting VS concept. Several parents traveled abroad for work and took their children with them. During that time children missed all that was happening in the school. But, by using VS, students and parents could remain updated about what was happening in the school. This made it easier to adjust when they came back and rejoined the school.

Before virtual school concept was formally launched for students and parents, the teachers and Classteacher.com personnel spent many days designing the basic content. Computer workshop for all subject teachers was conducted on four Saturdays. The teachers were taught basics of computing and little bit of Word and PowerPoint by computer teachers. Formal meetings of subject teachers with personnel from ClassTeacher.com were also conducted. A basic work plan was developed jointly. The products/services that were available in 2003 were a result of consistent trial and error efforts on both sides.

CT offered two basic services to DPS. It designed, developed, and maintained the school VS site in its servers. This site offered specific pages for students, teachers, and school management. The second important service CT offered was to prepare small animation based presentations on selected topics that could complement classroom teaching.

A student page contained information/activities under the following heads:

- Mails and notices
- Activities

- Learn and play center
- Syllabus
- School photographs
- Worksheets
- E-magazines

Each student had a unique ID. Using it, the student or the parent could go to the relevant pages and access provided materials/information. For example, all school notices could be viewed, parents could find out the syllabus for his/her child, and how it was scheduled month wise. The school also published the results of the students on the Net for the parents to view at their convenience. Exam papers from previous years were also put on the Net for the benefit of students. Parents could communicate with teachers regarding their children through e-mail. The school also uploaded digital images of latest events and celebrations at school so that parents could be connected to all that was happening at the school.

The 'Learn and Play Center' page had the following links:

- Home page
- Birthday of the month
- Fun lessons
- Digital library

A child could develop his/her home page by using the simple tools provided on the Website. 'Birthday of the month' page of the students whose birthdays had names fell during that month. Students could send e-greetings to each other. There were some interesting lessons under 'fun lessons.' Under 'Digital Library' Classteacher.com had provided links to several useful Websites that students could use and get relevant material/information for their project work. The links were appropriate to the age group of the student concerned.

'Worksheet' section was the most important where, with the help of CT, the school uploaded interesting assignments for students to work on. Though initially, it was planned to put homework on the Net, later it was decided to develop some special and interactive assignments also. Every week, the personnel of CT came to the school and collected materials from concerned subject teachers to develop worksheets and then uploaded them as assignments for students.

Each class was brought to the AV room once every week to see modules related to the chapters taught in the class that week. The text of these modules was normally given by the teachers and CT converted that text into a lucid story with relevant graphics, audio, video, and animation. The text more or less tried to augment the concept taught in class. Before screening, the module was checked by the subject coordinator. The class teacher also gave feedback after students had viewed the module. Students looked forward to these sessions every week. The school Website was developed by CT.



## Challenges

Initially introducing VS was not easy, as it required awareness to be created. Students were given write-ups about VS and informed about their benefits. Many students did not have Net connection in their homes. The school had to devise ways of providing Net access to all students.

Though informal hands-on-training had been provided to the teachers, still many of them were not computer savvy. The computer department had to handle the e-mails of those teachers. They gave a hard copy of e-mails received, to the concerned teachers and also sent e-mails on their behalf. Fortunately, the number of such teachers was small.

## Competition in the Virtual World: Unplanned Success

AT&T, Japan organized virtual classroom contest for schools. In the academic year 1998–99, DPS teamed up with schools from USA (Buck Lake Elementary School) and Canada (Smith Jackson Ukrainian Bilingual School) to design and host a website based on an AT&T proposed topic 'Our World, Our Perspectives.' The DPS team had 20 students and five teachers. Video conferencing was used to communicate between team members of the three schools. DPS students came to the school at night for video conferencing. Students came to know each other better through e-mail exchanges. The DPS team got the first prize and two students of DPS went to Hong Kong to receive the award and also to meet some of the team members from the other two schools. It was indeed a lifetime experience for all the team members.

## Future Plans

The next thing on the school's agenda is to introduce on-line testing. Objective type of questions can be handled by the computer and this can reduce the workload of teachers, who can now concentrate on subjective type of answers. However, infrastructure in the form of an adequate number of computers, would be a major bottleneck for this experiment. Teachers need to re-orient their attitude to on-line testing. However, the school is working on some creative solutions to handle these bottlenecks.

## APPENDIX-A<sup>1</sup>

### Sample Lesson Plans

**DiscoverySchool.com**

#### LESSON PLAN-1

**Technology at Work**

**LENGTH OF THE LESSON:** Two class periods

**GRADE LEVEL:** 3-5

**SUBJECT AREA:** Technology

**CREDIT:** Summer Productions, Inc.

**OBJECTIVES:** Students will understand the following:

1. Technology is defined as 'any invention, including tools, machines, materials, techniques, and sources of power, that makes people's work easier.'
2. The history of technology really begins in pre-historic times.

**MATERIALS:** For this lesson, you will need:

<sup>1</sup> Several activity sheets downloaded from DiscoverySchool.com have been put up as sample. All relevant copyrights are acknowledged.



- Research materials on the history of technology.
- Computer with Internet access.
- Long strips of paper.

## PROCEDURE

1. Ask your students what they think of when they hear the word *technology*. Ask them when they think technology began. Their answers are likely to center on modern technology, especially computer-related.
2. Let students know that technology is defined as 'any invention, including tools, machines, materials, and sources of power, that makes people's work easier.' Then ask them to reconsider their ideas about when technology began. They should realize that technology began the first time a human, or even a pre-human, used a stick or a rock as a tool or a weapon. Such advances as the ability to make fire, the development of agriculture, and the use of simple machines such as the lever or the inclined plane count as technology, as do electricity, nuclear power, and the computer.
3. Divide your class into groups, and have each group meet to brainstorm a list of at least ten technological advances they think should be included on a time line of the most important technological advances in human history.
4. Next, have students do research to find the dates for the technological advances they plan to include on their time lines. (Pre-historic technology can be dated simply by the word 'pre-historic.')
5. Students can make their time lines on long strips of paper they cut out and tape together or on brown paper that comes in rolls. Time lines should include illustrations of the technological advances students wish to highlight.
6. When all groups have completed their time lines, display them around the classroom. Invite students to compare the time lines to see which technological advances were included on most of them.

## ADAPTATIONS

Have students choose one of the six simple machines—inclined plane, lever, pulley, wedge, wheel and axle, or screw—and make a model or draw a picture of it.

## DISCUSSION QUESTIONS

1. Debate the issue of computers that think on their own. What would be the advantages of this level of computer intelligence? What would be the disadvantages?
2. How would your school be different if there were no computers? Survey the different parts of your school (office, cafeteria, etc.) to find out where computers are used. Discuss how work would be done without computers to help us.

3. Describe how your class might use e-mail.
4. What information might your class want to share on a Website? Remember this information could be text, photographs, drawings, sound, or video. Explain your design for a Website.

## EVALUATION

You can evaluate groups on their time lines using the following three-point rubric:

- Three points:* Includes more than 10 items; dates accurate; illustrations included; time line carefully prepared.
- Two points:* Includes at least 10 items; most dates accurate; illustrations included; time line satisfactorily prepared.
- One point:* Includes less than 10 items; several inaccurate dates; few or no illustrations; time line carelessly prepared.

## EXTENSION

### Technology Election

Have the class hold a 'nominating convention' for the single most important technological advance in human history. For each advance nominated, have students who would vote for it meet to prepare a 'campaign speech' that will persuade classmates to agree with them. After speeches have been given, hold an 'election' to see which technological advance the majority of students in the class think is most important.

### Make a Model

Have interested students work together to make models of the technological advances they consider most important. If a group of students choose something too complex for a model (e.g., a computer), the group members can produce a labeled diagram instead.

## SUGGESTED READINGS

Macaulay, David. 1995. 'The Way Things Work CD-ROM,' Dorling Kindersley.

(Read the section of this CD-ROM about computers and click on all the links to learn about connected topics.)

Cotton, Eileen. The Online Classroom. ERIC/EDINFO Press.

This book is designed to save teachers many hours of wandering in virtual space and offers a vast array of sample lessons of varying levels of sophistication. Each lesson provides goals, rationales, objectives, procedures, and evaluation guidelines.



## WEB LINKS

Blacksburg Visitor's Center. <http://www.bev.net/blacksburg/index.html>

Visit Blacksburg, Virginia the virtual way—on a computer! Check out the weather, transportation, maps, village mall, libraries, museums, and townspeople using the Internet.

## VOCABULARY

**Abacus:** A manual computing device consisting of a frame holding parallel rods strung with movable counters.

**Context:** This is an abacus. This counting machine was first used in China and the Middle East.

**Central processing unit:** The part of a computer that interprets and executes instructions.

**Context:** The bits are sent to the computer's brain, the CPU, where they are translated back into words and pictures and symbols on the screen.

**E-mail:** Messages sent and received electronically via telecommunications links.

**Context:** You can send an e-mail message from the U.S. to almost anywhere in the world in just seconds.

**Modem:** A device that converts information from your computer into signals that can travel through telephone lines.

**Context:** A modem takes information from your computer and turns it into a signal that can travel through the telephone lines.

**Uniform Resource Locator (URL):** The address of a Web page, which allows people to find the page on the Internet.

**Context:** A Web page address is called a URL; that is an acronym that stands for uniform resource locator.

**Scanner:** A device that allows one to convert pictures into images on the computer.

**Context:** You can also use a scanner to turn pictures into images on the computer that you can put on your Website.

## ACADEMIC STANDARDS

**Grade Level:** K-2

**Subject Area:** Science

**Standard:** Understand the nature of technological design.

**Benchmarks:** Know that some objects occur in nature, whereas others have been designed and made by people to solve human problems.

**Grade Level:** 3-5

**Subject Area:** Science

**Standard:** Understand the nature of technological design.

**Benchmarks:** Categorize items into groups of natural and designed objects.

**Grade Level:** 3–5

**Subject Area:** Science

**Standard:** Understand the nature of technological design.

**Benchmarks:** Know that designing a solution to a simple problem may have constraints, such as cost, materials, time, space, and safety.

**Grade Level:** 3–5

**Subject Area:** Science

**Standard:** Understand the interactions of science, technology, and society.

**Benchmarks:** Know that tools help scientists make better observations, measurements, and equipment for investigations.

**Grade Level:** 3–5

**Subject Area:** Science

**Standard:** Understand the interactions of science, technology, and society.

**Benchmarks:** Know that people have always had problems and invented tools and techniques (ways of doing something) to solve problems; trying to determine the effects of various solutions helps people avoid some new problems.

**Grade Level:** 3–5

**Subject Area:** Science

**Standard:** Understand the interactions of science, technology, and society.

**Benchmarks:** Know that people continue inventing new ways of doing things, solving problems and getting work done; these new ideas and inventions often affect other people; sometimes the effects are good and sometimes they are bad.

**Source:** <http://www.discoveryschool.com>



DiscoverySchool.com**LESSON PLAN-2****Computer Technology****LENGTH OF THE LESSON:** One class period**GRADE LEVEL:** 6-8**SUBJECT AREA:** Technology**CREDIT:** Jeffrey Leaf, a technology teacher at Thomas Jefferson High School for Science and Technology in Alexandria, Virginia.**OBJECTIVES:** Students will understand the following:

1. Inventions can change the way we live.
2. Many inventions start out with design flaws and are refined later by subsequent inventors and designers.
3. The computer, invented in 1834 by Charles Babbage and still being refined, is an example of such an invention.

**MATERIALS**

For this lesson, you will need:

- If possible, an encyclopedia dated 1980 or earlier, with an entry for computer.
- A computer with Internet access.

**PROCEDURE**

1. Ask students if they know who invented the computer. If they don't, inform them that in 1884, Charles Babbage, an English mathematician, tried to build a complicated machine called the 'analytical engine.' It was mechanical, rather than electronic, and Babbage never completed it, but computers today are based on many of the principles he used in his design. Your students may be interested to know that, as recently as 40 years ago, computers were so

large that they filled whole rooms. They were so complicated that only specially trained people were able to use them.

2. If you can find an encyclopedia dated 1980 or earlier, have students read the entry for *computer* and hold a brief discussion of computers then and now.
3. Ask students if they can think of any other inventions that changed the way we work and live. Can they trace changes and refinements in those inventions? An example might be the sewing machine, which, originally, was mechanical, rather than electric, and had to be operated by a foot pedal. Another might be the phonograph, which evolved into the CD player.
4. Tell the class that the activity in which they will participate will illustrate how inventions have evolved and are still evolving. Start by having students find partners.
5. Give each pair of partners the following assignment: Select a common, non-electric household item that you believe is important. Together, write down answers to the following questions about your item:
  - What need does this item fill?
  - What do you think the first one looked like?
  - How did it change?
  - How could it still be improved?
  - What might this item look like in the future? (Draw a sketch.)
6. After students have selected their items and answered their questions, have each pair of partners give an oral presentation on their findings.
7. Lead a class discussion about how the activity applies to computers and how they evolved and continue to evolve.

## ADAPTATIONS

### Adaptations for Older Students

Have students research computer history. Have each student choose an earlier stage of the computer and compare and contrast it with the ones we use today.

## DISCUSSION QUESTIONS

1. Babbage designed his mechanical computer in 1834. Why did it take electronics to make a practical computing machine?
2. The computer came from research by the U.S. Army to better fight wars. Should the U.S. spend money researching how to fight and kill better?
3. The Internet is blurring the lines between computing and communications. Is this a good thing? What are the positive and negative aspects of this technology?



## EVALUATION

You can evaluate your students on their assignments using the following three-point rubric:

- Three points:* All questions answered; sketch imaginative and carefully executed; oral presentation well-organized and presented in a clear and lively manner.
- Two points:* Most questions answered; sketch adequately executed; oral presentation clear and organized.
- One point:* Few questions answered; sketch missing or poorly executed; oral presentation lacking clarity and organization.

You can ask your students to contribute to the assessment rubric by determining criteria for a well organized and lively presentation.

## EXTENSION

### Dive into a Think Tank

The U.S. Government pays millions of dollars a year to 'think tanks.' These are organizations that research the state of things now and how they are going to be in future. In your class, establish think tank teams of people with varied interests. Their assignment is to develop an image of a possible American culture 50 years from now. They should consider these questions:

- What can the Internet do?
- How do people communicate?
- What new uses have been found for integrated circuits?
- What advances in health care occurred because of the computer and/or integrated circuit?
- What are the problems in society as a result of growth and development?
- What are the new job possibilities that don't exist today?

The culmination of the activity is an oral presentation by each team, painting the picture of the world they envision and giving reasons for their predictions.

### 'They can put a human being on the Moon, but...'

Ask your students if they can think of any thing we use in everyday life that is not very well designed. Do they think there are needs that no one has yet filled with the appropriate invention? Have students choose one of the following assignments:

- A. Find an item used at home, school, or another place you frequent, that is not designed well, and redesign it making it easier for people to use. (Designs may be presented as drawings or physical mock-ups. Mock-ups may be made from any material available. They do not necessarily

have to work, but should represent what the real item would look like, either full size or to scale.)

B. Think of a problem that hasn't been solved or a need that hasn't been met, and design an invention to provide a solution or fill that need. Respond in writing to the following:

1. Define the problem.
2. Give causes for the problem.
3. Describe your solution.
4. Explain why your solution will improve the situation.

Have students give a five-minute oral presentation, when they have completed either assignment A or B.

## SUGGESTED READINGS

Freed, Les. 1995. *The History of Computers*. Ziff-Davis Press.

With fascinating photographs which cover the earliest mechanical calculators, this Ziff-Davis publication offers the clearest and most entertaining history of computer technology. A 'must-read' title for this topic!

Stephens, Margaret and Rebecca Treays. 1995. *Computers for Beginners*. Usborne Publishing Ltd.

Despite cartoon-style illustrations, this resource offers sophisticated, detailed explanations regarding computer programs, essential hardware and software, and such accessories as mouse, scanners, and compact discs.

## WEB LINKS

Hubble Space Telescope Public Pictures. <http://www.oposite.stsci.edu/pubinfo/Pictures.html>

This is the official public information site from the STSI. Great pictures!

The Computer Collection. <http://www.msn.fullfeed.com/~cube/collect.htm>

One man's collection of old computers!

Pierce Computer Collection. <http://www.teleport.com/~prp/collect/index.html>

Great links and photographs of the technological development of computing and machines designed to carry out operations.



Information Age: People, Information & Technology. <http://www.photo2.si.edu/infoage.html>  
An excellent starting point for previewing discussion on 'Invention: Computer Technology.'

Star Logs Archive. <http://www.discovery.com/area/specials/hubble/hubble1.4.html>  
Using information from this site, have students report on how problems on hubble have been resolved with refined technological developments.

Chronology of Events in the History of Microcomputers. <http://www.islandnet.com/~kpolsson/comphist.htm>

## ACADEMIC STANDARDS

**Grade Level:** 9–12

**Subject Area:** History

**Standard:** Understand the historical perspective.

**Benchmarks:** Understand how the past affects our private lives and society in general.

**Grade Level:** 6–8

**Subject Area:** Technology

**Standard:** Understand the interactions of science, technology, and society.

**Benchmarks:** Know that science and technology have advanced through the contributions of different people, in different cultures, and at different times in history. Science and technology have contributed to the economic growth and productivity of societies and this, in turn, results in social changes with different effects on societies and groups within them.

**Grade Level:** 9–12

**Subject Area:** Science

**Standard:** Understand the interactions of science, technology, and society.

**Benchmarks:** Know that individuals and society must decide on proposals involving new research and technologies; decisions involve assessment of alternatives, risks, costs and benefits, and consideration of who benefits, who suffers, who pays, who gains, what are the risks, and who bears them.

**Source:** <http://www.discoveryschool.com>

## LESSON PLAN-3

### The Real Bionic Man

**LENGTH OF THE LESSON:** Two class periods

**GRADE LEVEL:** 9-12

**SUBJECT AREA:** Technology

**CREDIT:** Mary Ann Herbst, Science Teacher, Thomas Jefferson High School for Science and Technology, Alexandria, Virginia.

**OBJECTIVES:** Students will understand the following:

1. Scientists have been working for years on sophisticated artificial human parts, including technologically superior artificial limbs, hearing devices implanted in the cochlea, and eyes that transmit electric signals to the visual cortex.
2. Their work is already being used to help people with disabilities.
3. In an artificial human part, each device functions in place of an actual biological structure.

**MATERIALS:** For this lesson, you will need:

- Research materials on the human eye and brain.
- Computer with Internet access.

### PROCEDURE

1. Initiate a class discussion centering on what your students know about cyborgs and recent work of scientists who are creating sophisticated bionic human parts to help people with disabilities.
2. Encourage them to use the Internet to find out more about the work of Professor Richard Norman, who is attempting to restore sight by stimulating the brain in a normal fashion.
3. Encourage students to share their findings, making sure they are all aware that Norman is utilizing a video camera, microchips, and a microelectrode array to send signals to the visual cortex of the brain. (Alternately, tell the class about Norman's work.)
4. Tell students that each device used in Norman's bionic 'eye' corresponds to an actual biological structure in the human eye or brain.



5. Challenge students to use research materials to determine the biological structure(s) that correspond to the following devices:

- Video camera
- Microchips
- Microelectrode array

6. Students should draw a clearly labeled diagram of each device and another diagram of the biological structure to which the device corresponds. Each pair of diagrams (device and corresponding biological structure) should be accompanied by a short explanation of the function of the device and structure.

## ADAPTATIONS

Provide students with a labeled diagram of the human eye, optic nerve, and brain. Hold a class discussion in which students match up parts of the human eye and brain to the three devices used in Professor Norman's bionic 'eye.'

## DISCUSSION QUESTIONS

1. What technological advances must occur before bionic implants can become a reality?
2. Materials technology is very much a part of the development of bionic parts. What space age materials are depicted in the video?
3. Bionic enhancement will give rise to many ethical issues, such as the factors used in determining who receives the implants. What other issues might arise?
4. Which mechanism of enhancement is preferable—electromechanical (e.g., bionic eyes, prosthesis) or biological (e.g., genetically engineered replacement tissue)? Why?
5. Why is implantation of bionic components so important?
6. Development of bionic humans might require redefinition of the term handicapped. Would a separate category of enhanced individuals be appropriate?

## EVALUATION

You can evaluate your students on their diagrams and explanations using the following three-point rubric:

*Three points:* Artificial devices and biological structures correctly paired; all six diagrams provided; all diagrams accurate and clearly labeled; explanations of functions correct and clearly stated.

*Two points:* Artificial devices and biological structures correctly paired; all six diagrams provided; most diagrams accurate and clearly labeled; explanations of functions correct, but lacking in clarity.

**One point:** Artificial devices and biological structures incorrectly paired; some diagrams missing; some diagrams inaccurate, not labeled correctly, or not labeled at all; some explanations inaccurate.

You can ask your students to contribute to the assessment rubric by determining how devices and structures should be paired.

## EXTENSION

### The Bionic Time Line

Invite students to use the Internet to build a time line of technological and medical advancements in the field of bionics over the last century. Suggest a timescale that will allow students to see the rapid rate of increase in advancements. Students should choose a starting point that is relevant to them—perhaps the decade in which their parents were born. After the time line is completed, have students predict when the first bionic eye, bionic ear, and so on will be implanted.

### Measuring Sensory Input

The greatest difficulty in developing artificial hands and arms has been a lack of sensory input. Have students conduct an experiment that will illustrate this problem. For example: Design an activity that requires manipulation of small objects, such as tracing a toothpick or tying a shoelace. Have students perform the activity normally. Then have them apply to the ends of their fingers lotion for relief of sunburns or fever blisters, which will cause a numbing effect. Then they can repeat the experiment and compare results.

### Build Your Own Six Million Dollar Man (or Woman)

Divide the class into groups, and have each group choose a specific organ or system in the human body to research. Groups should use the Internet to research all the functions of the chosen organ or system. Next, group members should work together to design a bionic replacement that will perform equally well. Each design must include a statement of warranty on parts and labor, and predict what level of maintenance the bionic part would require. Have students determine prices for their designs. Then the class as a whole can estimate the cost for a fully assembled bionic person.

## SUGGESTED READINGS

Hawkins, Dana. 1995 (March 20). *Inventing the News*. U.S. News and World Report.

U.S. News describes the exciting biomedical engineering research being conducted across American campuses, and offers its survey-based ranking of the top 50 graduate schools in this field.



## WEB LINKS

The Whitaker Foundation: Biomedical Engineering News. <http://www.whitaker.org/news/news.html>  
Read descriptions of the latest biomedical research being performed, including the use of polymers in heart surgery and administering insulin shots without needles.

Neural Prosthetic Devices. <http://www.socalbio.org/newsletter/fall96/opel.htm>  
Discusses the use of a bionic electrode being used to restore bodily functions lost through injury or disease.

AIPO—Bionic Ear Patent. [http://www.aipo.gov.au/fun/patents/02/fun\\_ear.htm](http://www.aipo.gov.au/fun/patents/02/fun_ear.htm)  
This is the patent of the Cochlear bionic ear implant. The site describes the device and gives a graphic image of the design.

Bionic Valve Project. [http://ic-www.arc.nasa.gov/ic/projects/neuro/brain/bio\\_valve.html](http://ic-www.arc.nasa.gov/ic/projects/neuro/brain/bio_valve.html)  
Shows with photos and drawings how a robot is used in surgery to help locate a tumor and to prevent damage to arteries.

Bionic Technologies, Inc. <http://www.bionictech.com/>  
This is the home page of a company that specializes in developing bionic technologies. The site gives reports on current advances in bionic research.

Cyborgs. <http://www.tip.net.au/~davidjw/libdata/clonfram.htm>  
Describes a cyborg, offers links for identifying the different types of body replacement parts.

Online Movements from Integrated Orbital Implants. <http://www.ioi.com/comments.html>  
The most up-to-date and comprehensive resource for information about developments in ocular implants and artificial eyes.

## VOCABULARY

**Cyborg:** A composite being in which living and artificial components are combined.

**Context:** By definition he is a cyborg—a man-machine hybrid.

**Microchip:** An electronic circuit that consists of components of very small size.

**Context:** Their plan is to link a video camera to a microchip embedded in the visual cortex.

**Laser:** Light Amplification by Stimulated Emission of Radiation. A device that converts incident electromagnetic radiation of mixed frequencies to discrete frequencies of highly amplified and coherent visible radiation.

**Context:** They also intend to use a pair of camera glasses, but this time the TV signal will not go directly to the brain but will be sent by a laser into the eye.

**Carbon fiber:** A technologically advanced material which has the properties of high strength and light weight.

**Context:** It is made of carbon fiber, weighs only four-and-a-half pounds, has 10 speeds and a shock absorber.

**Prosthesis:** An artificial replacement for a missing body part.

**Context:** It is the most important part of the whole prosthesis.

**Actuators:** Devices that put an object into motion.

**Context:** There isn't space for all of the man-made actuators that we would like to install to move every joint of an artificial limb.

## ACADEMIC STANDARDS

**Grade Level:** 9–12

**Subject Area:** Physical Science

**Standard:** Understand energy types, sources, and conversions, and their relationship to heat and temperature.

**Benchmarks:** Know that the energy of waves (electromagnetic and material) can be changed into other forms of energy (chemical and electrical), just as other forms of energy (chemical and nuclear) can be transformed into wave energy.

**Grade Level:** 9–12

**Subject Area:** Physical Science

**Standard:** Understand motion and the principles that explain it.

**Benchmarks:** Know that waves (sound, seismic, light, water) carry energy and can interact with matter.

**Grade Level:** 9–12

**Subject Area:** Technology

**Standard:** Understand the nature of scientific knowledge.

**Benchmarks:** Know that because all scientific ideas depend on experimental and observational confirmation, all scientific knowledge is, in principle, subject to change as new evidence becomes available; in areas where data, information, or understanding is incomplete, it is normal for scientific ideas to be incomplete, but this is also where the opportunity for making advances may be greatest.

**Grade Level:** 9–12

**Subject Area:** Technology

**Standard:** Understand the nature of technological design.

**Benchmarks:** Propose designs and choose between alternatives (models, simulations).



**Grade Level:** 9-12**Subject Area:** Technology

**Standard:** Understand the interactions of science, technology, and society.

**Benchmarks:** Know that science often advances with the introduction of new technologies and solving technological problems often results in new scientific knowledge; new technologies often extend the current levels of scientific understanding and introduce new arenas of research.

**Grade Level:** 9-12**Subject Area:** Technology

**Standard:** Understand the interactions of science, technology, and society.

**Benchmarks:** Know that science and technology are pursued for different purposes; scientific inquiry is driven by the desire to understand the natural world and seeks to answer questions that may or may not directly influence humans; technological design is driven by the need to meet human needs and solve human problems and has a more direct effect on society than science because its purpose is to solve human problems; help humans adapt, and fulfill human aspirations.

**Source:** <http://www.discoveryschool.com>

## APPENDIX-B

### Sample IT Strategy Mothers' International School, New Delhi

Steps taken by the Mother's International School to enable the integration of technology into the school's teaching process.

#### IMPLEMENTATION PLAN

##### 1. Faculty training

- i. Introduction of Intel, 'Teach To the Future Programme' through which all 100 teachers were successfully trained in March–April 2000.
- ii. Two teachers, Mr Dash and Ms Anu Dhir successfully qualified as master trainers and achieved their targets of training 22 more teachers in the sister institutions on our campus during the summer vacations.

Thus, the school achieved 100 percent computer literacy amongst its staff members.

##### 2. Creation of Content-based data bank

- i. All the teachers worked towards preparing a minimum of two lesson plans during the summer vacations. To facilitate the teachers in preparing of their lesson plans, the computer labs were kept open throughout the summer vacations with the master trainers providing the necessary guidance, where required.
- ii. Thus, mapping the information available to the syllabus requirements was made possible. The process still continues.
- iii. A resource bank of lesson plans/latest information in various disciplines was created and the process still continues.



### 3. Infrastructural facilities

- i. The School computer lab was upgraded with 25 new Pentium-III machines. The old Pentium machines (25 nos.) were distributed to various departments, so as enable the teachers to have ready access to practice and upgrade their newly acquired computer skills. It also provided them easy access for undertaking in-depth research work through the Internet.
- ii. A new multimedia lab was gifted to the school with an Internet station, by Intel for the most effective integration of technology into the curriculum. This has gone a long way in generating greater enthusiasm in the area of computer aided learning, with easy access to information through the Internet.
- iii. The Library has been provided with five computers which will be linked to e-library.
- iv. The Institution presently has 75 computers and they have all been brought under a common networking. Besides this, every teacher has been given her/his own e-mail address to enable the students to interact with their teachers online.

### 4. Integration of technology in lessons/classroom teaching

- i. The use of technology brought a paradigm shift in the class room from the traditional learning atmosphere by incorporating the use of technology in classroom teaching with the aim of developing of critical thinking skills, etc.
- ii. The teachers were initially given the flexibility of selecting the subject area and topic of their choice with the understanding, that every teacher will incorporate technology in at least two lessons every term (though many have opted to do more) and to record the number of students taught, student activities undertaken, the degree of achievement of the learning objectives, along with students reactions/suggestions. They were asked to record the source of information (whether from CDs or Internet or scanning from encyclopedias).
- iii. A teacher coordinator was asked to draw up a timetable to facilitate the optimum utilization of computer lab by every teacher.
- iv. Teachers were given a list of websites for guidance to improve their lesson plans. A CD library was built up for this purpose.
- v. The other teachers of the department were invited to observe the integration of classroom teaching through multimedia by their colleagues. This created a healthy platform for discussion and sharing of experiences. In this way, every presentation was an improvement over the previous one.

Teachers were able to discuss issues, curriculum and best practices not only with their colleagues but also with teachers across the globe.

### 5. Student program

- i. In the primary wing, Computer Education has been made compulsory from class III upwards so that the juniors get a feel of the machine and learn the basics. This will enable them to competently utilize their computer skills for undertaking research in their project work and other presentations as required of them in senior school.

- ii. A summer camp in computer education was organized for students of different age groups keeping in mind their competency level.
- iii. A computer club 'MINET' has been inaugurated for students and teachers having advanced knowledge in the fields of technology, so as to allow the gifted to pursue a higher level of learning. They have been instrumental in developing the school web site and giving an e-mail address to every teacher. Various competitions and other events were organized by the club through the use of technology. They are now working with the guidance of ex-students of the school on the automation of the school library. The members of the club, along with the faculty of the Computer Department, are undergoing training with Educomp Datamatics to update themselves on the use of the latest software like Dream Weaver (Version IV), Flash v, etc.
- iv. Many students on their own initiative, prepared their holiday homework through PowerPoint presentation.
- v. Two students from the Computer Science batch from classes XI and XII will assist one teacher in making further computer-related programs as part of their project work. The same, after evaluation, will be submitted to the library for future use.
- vi. Informatics has been introduced as a subject at the senior secondary level.

*Today's preparation determines tomorrow's achievement*



## APPENDIX-C

### Resource List

#### SOME LEADING HARDWARE MANUFACTURERS

IBM India Ltd.  
<http://www.ibm.com>

Golden Towers  
Airport Road  
Bangalore-560 017

HCL Infosystems Ltd.  
<http://www.hclinfosystems.com>

E-4, 5, 6 Sector 11,  
NOIDA-201 301, UP  
Tel: 91-4526518/19  
Fax: 91-4550923

Compaq India Ltd.  
<http://www.compaq.com>

Digital Park, 92, Industrial Suburb  
II Stage, Yeswanthpur  
Bangalore-560 022  
Tel: 080-3374785  
Fax: 3374601/3374395/3374225

Wipro Infotech Ltd.  
<http://www.wipro.com>

Doddakannelli Sarjapur Road  
Bangalore-560 035  
Tel: 080-8440315  
Fax: 080-8440256

Hewlett-Packard (India) Ltd.  
<http://www.hp.com>

Chandiwala Estate  
Maa Anand Mai Marg  
New Delhi-110 019  
Tel: 91-011-6826000  
Fax: 91-011-6826030

## SOFTWARE

| <i>Software</i>       | <i>Publisher/Distributor</i>                                                                                                                                    | <i>Use</i>                      |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| MS-Office             | Microsoft India Pvt. Ltd.<br>The Great Eastern Center<br>70, Nehru Place<br>New Delhi-110 019<br>Tel: 011-26294600,<br>26294601                                 | Integrated software             |
| Corel Draw            | Corel Publishing                                                                                                                                                | Graphics                        |
| MS-Publisher          | Microsoft                                                                                                                                                       | Page making                     |
| DreamWeaver/FrontPage | Macromedia/Microsoft                                                                                                                                            | HTML Editor                     |
| Flash/Fireworks       | Adobe (Macromedia)                                                                                                                                              | Graphics for websites           |
| Macromedia Director   | Adobe (Macromedia)                                                                                                                                              | Authoring                       |
| Mathematica           | Wolfram Research, Inc.                                                                                                                                          | Mathematics                     |
| SPSS                  | SPSS Inc.                                                                                                                                                       | Statistical processing          |
| MapInfo               | MapInfo Corporation                                                                                                                                             | Geographical Information System |
| LibSys                | Info-Tek Consultants Pvt. Ltd.<br>633-A, Phase-V,<br>Udyog Vihar,<br>Gurgaon-120 016,<br>Haryana<br>Tel: 0124-2451119/1120/<br>0202/0203<br>info@libsys.co.in   | Library Management              |
| Alice for Windows     | Softlink Asia Pvt. Ltd.<br>K-139 Kalkaji, 102-104 F.F.<br>New Delhi-110 019<br>Tel: 011-6474967/5047<br>softasia@del3.vsnl.net.in<br>http://www.softlink.com.au | Library Management              |
| e-learning products   | dayanidhi@excelindia.com                                                                                                                                        |                                 |
| School automation     | Saral Academics<br>1117/1, Sector 44-B,<br>Chandigarh<br>Tel: 2624159                                                                                           | Timetable Management            |

(Appendix continued)



(Appendix continued)

| Software | Publisher/Distributor                                                                                                                                                                   | Use                        |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
|          | Defacto Infotech<br>SCO 128-129 Top Floor<br>Sector 8C, Chandigarh<br>Tel: 2387789, 2387791                                                                                             | Library Automation         |
|          | Algorithm Infosoft Pvt. Ltd.<br>C-54 A, Sector-56, Noida, UP<br>Tel: 0120-2589073,<br>2580920<br>algorithm@aisnoida.com                                                                 | School Management Software |
|          | Significant Software Solutions<br>http://www.ttable.com<br>B-52 Somdutt Chambers-1,<br>5, Bhikaji Cama Place,<br>New Delhi<br>significant@ttable.com                                    | School Management Software |
|          | Mr Kamal Khurana<br>Software Consultants (India)<br>http://www.samsoft.com<br>212, Kaveri Complex<br>Meerut-250 001<br>Tel: 0121-2650694<br>Mob: 9412200831<br>softconsultants@vsnl.net | School Management Software |
|          | AIT'S<br>http://www.auroinfo.com<br>Plot 586/C, Rasulgarh,<br>Bhubaneswar, Orissa<br>Tel: 9437010585,<br>0674-2580585<br>info@auroinfo.com                                              | School Management Software |
|          | Pac Soft Solutions Ltd.<br>http://www.pac-soft.com<br>B, 'Live in Style,'<br>12, Pottery Road,<br>Richmond Town<br>Bangalore-560 005                                                    | School Management Software |

(Appendix continued)

(Appendix continued)

| Software | Publisher/Distributor                                                                                                                                                                                                                                 | Use                        |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
|          | V.S. Silicon Education India Ltd.<br><a href="http://www.vssilicon.com">http://www.vssilicon.com</a><br>'Silicon House', 29-C,<br>Rajpur Road,<br>Opp. St. Joseph's Academy,<br>Dehradun-248 001<br>Tel: 0135-2712916, 2712917<br>Mob: +91-9837092922 | School Management Software |
|          | Limitless Software India<br><a href="http://www.limitless.net">http://www.limitless.net</a><br>2nd Floor, No. 1, 2nd Main,<br>Sultan Palya, R.T. Nagar,<br>Bangalore-560 032<br>Tel: 80-2353-4893, 2333-7782                                          | School Management Software |

## INDIAN EDUCATIONAL CD PUBLISHERS

| Name                                                                                                  | Address                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| BPB Multimedia                                                                                        | Munish Plaza, 20 Ansari Road<br>Daryaganj, New Delhi                                                                                         |
| Divine Computers Pvt. Ltd.<br><a href="http://garodia@satyam.net.in">http://garodia@satyam.net.in</a> | Vikas Garodia<br>CP-8, NH-5, Railway Road<br>N.I.T., Faridabad, Haryana-121 001<br>Tel: 0129-25412106/25410764                               |
| Educomp Datamatics Pvt. Ltd.<br><a href="http://www.edumatics.com">http://www.edumatics.com</a>       | 1211, Padma Tower-1,<br>5, Rajendra Place<br>New Delhi-110 008<br>Tel: 011-25755920/25762725                                                 |
| Information Technology India Ltd.<br><a href="http://www.ital.com">http://www.ital.com</a>            | A-41, Mohan Co-operative Estate<br>Mathura Road<br>New Delhi-110 044<br><a href="mailto:knowledgeaware@ital.com">knowledgeaware@ital.com</a> |
| Inndsoft Systech Ltd.<br><a href="http://www.ssi-inndsoft.com">http://www.ssi-inndsoft.com</a>        | 5, Karpagam Gardens<br>II, Main Road, Adayar<br>Chennai-600 020<br>Tel: 044-24461833/2124                                                    |

(Appendix continued)



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| Name                                                                                                                               | Address                                                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Jiva Institute<br><a href="http://www.jiva.org">http://www.jiva.org</a>                                                            | 1144, Sector 19<br>Faridabad, Haryana<br>Tel: 0129-2296174, 5041541<br><a href="mailto:info@jiva.org">info@jiva.org</a>                                                                        |
| Maya Software Technologies<br><a href="http://www.maya123.com">http://www.maya123.com</a>                                          | 804-A, Manjusha Building,<br>57, Nehru Place, New Delhi-110 019<br>Tel: 11-51395353, 26421354                                                                                                  |
| Microsoft Corporation (I) Pvt. Ltd.<br><a href="http://www.microsoft.com/india">http://www.microsoft.com/india</a>                 | 9th Floor, Tower A, DLF Cyber Greens,<br>DLF Cyber Citi, Sector 25A<br>Gurgaon-122 002<br>Tel: 0124-5158000/2567000                                                                            |
| Milestone Interactive Software Ltd.<br><a href="http://www.milestoneinteractive.com">http://www.milestoneinteractive.com</a>       | Bldg No-3, Western Industrial Co-op. Estate<br>MIDC, Andheri (E)<br>Mumbai-400 093<br>Tel: 22-8381614/15<br><a href="mailto:sales@milestoneinteractive.com">sales@milestoneinteractive.com</a> |
| Navneet Edutainment Limited<br><a href="http://www.navneet.com">http://www.navneet.com</a>                                         | Navneet Bhawan, Bhabani Shankar Road,<br>Dadar West, Mumbai-400 028<br>Tel: 022-56626565                                                                                                       |
| NIIT<br><a href="http://www.niit.com">http://www.niit.com</a><br><a href="http://www.netvarsity.com">http://www.netvarsity.com</a> | 8, Balaji Estate<br>Sudarshan Munjal Marg Kalkaji,<br>New Delhi-110 019<br>Tel: 011-26482054                                                                                                   |
| Pentamedia Graphics Ltd.<br><a href="http://www.penta-media.com">http://www.penta-media.com</a>                                    | No.1, First Main Road<br>United India Colony<br>Chennai-600 024<br>Tel: 044-24833067/24839853<br><a href="mailto:bizdev@penta-media.com">bizdev@penta-media.com</a>                            |
| Pitamber Publishing Co. P. Ltd.                                                                                                    | 888, East Park Road<br>Karolbagh, New Delhi-110 005<br>Tel: 011-3670067, 3522997<br><a href="mailto:pitamber@bol.net.in">pitamber@bol.net.in</a>                                               |
| Pitara Kids Network Pvt. Ltd.<br><a href="http://www.pitara.com">http://www.pitara.com</a>                                         | 4195, Block B, Pocket 5 and 6,<br>Vasant Kunj, New Delhi<br>Tel/Fax: 26124326, 26139781                                                                                                        |

(Appendix continued)

(Appendix continued)

| Name                                                                                                                                                                    | Address                                                                                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| ILFS Education Technology Services<br><a href="http://www.ilfsindia.com">http://www.ilfsindia.com</a>                                                                   | Plot C22, G Block<br>Bandra Kurla Complex<br>Bandra East, Mumbai 400 051<br>Tel: 022-2653 3333/3232                  |
| Stardotstar Software Ltd.<br><a href="http://www.software-show.com">http://www.software-show.com</a><br><a href="http://www.schoolrom.com">http://www.schoolrom.com</a> | 18 and 19, Third Floor, Gemini Parsn Complex<br>Chennai-600 006<br>Tel: 044-28258464/2826335<br>stardotstar@vsnl.com |
| Times Multimedia<br><a href="http://www.timesmm.com">http://www.timesmm.com</a>                                                                                         | Bennett, Coleman & Co. Ltd.<br>The Times of India Bldg.,<br>Dr D. N. Road<br>Mumbai-400 001                          |

**FOREIGN EDUCATIONAL CD PUBLISHERS**

Broderbund  
 Bytes of Learning  
 Compton's Home Library  
 Davidson & Associates  
 Discis Knowledge Research  
 Disney Interactive  
 DK Multimedia  
 DreamWorks Interactive  
 Edmark Corporation  
 Edutech (IBM)  
 Harvard Associates  
 Hasbro Interactive  
 Houghton Mifflin Interactive  
 Jostens Learning  
 Knowledge Adventure  
 Laureate Learning Systems  
 Learn Technologies Interactive  
 Maxis Software  
 Microsoft  
 Scholastics Corporation  
 Softkey International  
 The American Education Company  
 The Learning Company  
 Torstar Corp.  
 Wayzata Technologies



## SOME SERVICE PROVIDERS

| Organization                                                                                                                                                                                                      | Service                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Mindshaper Technologies Pvt. Ltd.<br><a href="http://www.classteachers.com">http://www.classteachers.com</a><br>A-9/37, Vasant Vihar,<br>New Delhi-110 057<br>Tel: 011-2614 6802/6805/5829                        | Some virtual school facilities              |
| Intel Asia Electronics, Inc.<br><a href="http://www.intel.com">http://www.intel.com</a><br>21, Nehru Place, Suite 311<br>Paharpur Business Centre<br>New Delhi-110 019<br>Tel: 011-26419757/597                   | Training of teachers                        |
| Magic Software Pvt Ltd.<br><a href="http://www.magicsw.com">http://www.magicsw.com</a><br>D-107, Sector 2<br>Noida-201 301<br>Tel: 0120-305 4300                                                                  | Customized e-learning modules               |
| Meta-I Technologies P. Ltd.<br><a href="http://www.metaitechnologies.com">http://www.metaitechnologies.com</a><br>No. 3, NSRCEL<br>Indian Institute of Management<br>Bannerghatta Main Road,<br>Bangalore-560 076 | Outsourcing of school management operations |

## VIDEOS

| Publisher                                             | Address                                                                            | Some Titles                                         |
|-------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------|
| ET&T                                                  | Akbar Bhawan Annexe,<br>New Delhi<br>Tel: 011-26876078                             | Margdarshan                                         |
| Ministry of Information & Broadcasting<br>Doordarshan | New Delhi<br>Parliament Street,<br>New Delhi                                       | Bharat Ki Ek Khoj<br>Turning Point<br>Science Quest |
| Marg Publications                                     | Army and Navy Building,<br>3rd Floor<br>148, Mahatma Gandhi Road<br>Mumbai-400 001 |                                                     |

## JOURNALS AND MAGAZINES

| <i>Journal/Magazine</i>      | <i>Publisher</i>                                                            |
|------------------------------|-----------------------------------------------------------------------------|
| Electronic Learning          | Scholastics                                                                 |
| Computer & Education         | Elsevier                                                                    |
| Educare                      | Media Transasia Ltd                                                         |
| Primary Teacher              | NCERT<br>Aurobindo Marg<br>New Delhi                                        |
| Indian Educational Review    | NCERT                                                                       |
| Indian Educational Abstracts | NCERT                                                                       |
| School Science               | NCERT                                                                       |
| Education Today              |                                                                             |
| Resonance                    | Indian Academy of Science,<br>Bangalore                                     |
| Science Reporter             | National Institute of Science<br>Communication and Information<br>Resources |
| Education World              |                                                                             |
| Parenting                    | Media Star                                                                  |
| Computers Today              | Living Media                                                                |
| Computers@Home               | Cyber Media Publications                                                    |
| Sanctuary Asia               | <a href="http://www.sanctuaryasia.com">http://www.sanctuaryasia.com</a>     |



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**Neharika Vohra** is Associate Professor at the Indian Institute of Management, Ahmedabad. Her training in educational, developmental, social and cross-cultural psychology, and subsequent work experience with teachers, principals, and education administrators has contributed to her interest in areas such as leadership, psychometric testing and selection, and training and development. Dr Vohra conducts training programs for principals at IIM-A and is also involved in teacher training at various schools in India and abroad. She has published several papers in national and international journals.





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07/02/08





Recognizing the potential of ICTs to make the classroom transaction of curriculum significantly more relevant and purposeful, principals and school administrators in India need to design appropriate IT strategies and oversee the entire implementation process in their schools. This book is a guide to the use of ICT in schools, covering issues of pedagogy, curriculum and learning. In brief, it deals with

- educational uses of IT
- criteria for selection of hardware and software
- designing an IT-assisted curriculum
- teacher recruitment, training and desired competencies
- management and financial issues
- possible problem areas: plagiarism, privacy, hacking

Lucidly written, with case studies highlighting successful strategies, this volume will be of immense importance to principals and administrators of schools as also students of education.

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**Laxman Mohanty** is Director, Silicon Institute of Technology, Bhubaneswar.

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